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EDITORIAL

CAREERS

The present number of *The Philippine Agriculturist* will fall into the hands of the new students in the College of Agriculture. The introduction of first year men at the college of their choice is frequently surrounded with doubts and questions. To many a student, matriculation in college is his first experience away from home, and in the Philippines, with its barrio life which is in many ways admirable from a social standpoint, this means a great deal. Changes in vernacular, new friends, new faces, strange details confront the freshman at every step. But above all this, one great thought occupies his mind—his career. The strongest element in the make-up of a Filipino freshman is ambition and his constant goal is his career.

There are, however, a few points in regard to careers which should be emphasized and in doing so I shall address myself directly to the entering students of the College of Agriculture.

First of all, you are not to suppose that you are to become free agents, you are not to think that it is only the career of Juan or Pedro that you plan. Never! You who enter the College of Agriculture must face the fact that you are not only to make careers for yourselves but a career for your nation and a career for your race. When a nation is old and worn, when it holds the trophies of successful wars, when its furrows run from its mountain crests to its shores, when its resources are opened and expended, when its products are stabilized and its ships sail with confidence, when its institutions and its culture are fixed, and their magnitudes measured, there is left little of importance for the individual. He has become in this case a detail of a great general average—a unit, that may be disregarded, unrecognized, and over-stepped in the mechanism of the nation. In such a nation, Juan or Pedro may be lazy or extravagant or criminal, and the country may not suffer. In such a nation, a university may go to smash, or a whole class of students may fail to be graduated and there may be no perceptible faltering in the progress of the country. The career that any individual in such an environment chooses is largely his own affair and not the concern or policy of a government. But you, young men, have not been born into old things and old customs. Your generation is coincident with the birth of a nation. If you fail, if your careers shall not be successful, even a casual observer may see the damage done to your country. If this College of Agriculture does not succeed, your people will be the poorer; and the College can succeed only if its students

succeed. Think, then, not only of position and of prestige, but of service, and so plan your careers that the entire social fabric of the Philippines will have improved as a result of your having been here educated and trained.

A second point which should be emphasized whenever young men set forth to make their careers is the time element. Are you interested in yourselves in 1930 or in 1950? Are the careers that you are planning for yourselves the ones they shall be in 1930, the year after your graduation, or are you thinking of your careers of 1950, twenty years after you have graduated. Perhaps more graduates of the College of Agriculture have failed to achieve their possible measure of success through a lack of understanding of the time element than through any other cause.

You will fail if you expect merely to use the College of Agriculture as a coaching school for a given job in a given bureau at a given salary. You will never succeed if you look upon education as a fixed asset, a sort of a ticket, which once obtained, is a sure pass to a government salary and social rank. You should know that the things you will learn here are but the equipment for a much later consummation; that this equipment will be lost unless it is cherished and increased; that in any event it will not reach its full bloom until many years of experience have added wisdom to knowledge. Do not be concerned with the Juan or Pedro of 1930 but plan your careers to come to their fulfillment when you have reached the prime of life.

Let your careers be based upon activity, thrift, honesty, and courage. Remember that the progress of your race and of these, our beautiful Islands, depends upon the spirit of the fearless, forward-going pioneer, the will to do all, to face all, the restlessness that brings success, the activity—that Western spirit that long since offered itself to the Orient for emulation. The Prophet of the Pioneer was Walt Whitman and his lines are these:

Come my tan-faced children,
Follow well in order, get your weapons ready.
Have you your pistols? Have you your sharp-edged axes?
Pioneers! O Pioneers!

For we can not tarry here,
We must march my darlings, we must bear the brunt of danger.
We the youthful sinewy races, all the rest on us depend.
Pioneers! O Pioneers!

Not for us the delectations sweet.
Not the cushion and the slipper, not the peaceful and the studious,
Not the riches safe and palling, not for us the tame enjoyment,
Pioneers! O Pioneers!

Do the feasters gluttonous feast?
Do the corpulent sleepers sleep? Have they lock'd and bolted doors?
Still be ours the diet hard, and the blanket on the ground.
Pioneers! O Pioneers!

Till with sound of trumpet;
Far, far off the daybreak call—hark! how loud and clear I hear it wind,
Swift! to the head of the army! swift! spring to your places,
Pioneers! O Pioneers!

Evett D. Hester,
Of the Department of Rural Economics.

CORRELATION WITHIN PURE LINES OF RICE[1]

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INTRODUCTION

One of the most striking features of rice (*Oryza sativa*, L.) is its multiplicity of varieties. These varieties differ from one another in extremely varied characters. It is on these characters, both morphological and physiological, that varietal classification in rice is based. Equally important in varietal classifying of rice, is the knowledge of correlation, or association of characters. As one authority wrote: "The great value to the breeder of definite knowledge of correlation within a species is that it gives reliable information enabling him to predict from the presence of certain characters the most probable values of associated characters".

Previous study of the correlation of characters in rice has been mostly among varieties. It may not be out of place to state in this connection that varietal correlation (correlation among varieties) may or may not give the same value as that which may be furnished by correlation within a variety. A possible case is the varietal correlation between yield and height of plant. A short variety may give as much yield as a tall one, and yet within a variety tall plants may always yield more heavily than shorter individuals. A difference, which may be either significant or insignificant, may be found in these two kinds of correlation, varietal and line. The degree of variability among varieties taken collectively is bound to be different from that among individuals within a variety and the difference is probably greatest in a pure line, If the variability of characters be taken to serve as a relative index of the coefficient of correlation, the extent of association existing between characters among rice varieties need not be the same as that in plants within a variety. Data on the correlation of characters in a pure line should be highly instructive and useful.

PAST WORK ON CORRELATION OF CHARACTERS IN RICE

The various correlation studies here surveyed are grouped into: (a) correlation within a variety, and (b) correlation among varieties.

Correlation within a variety.—Van Der Stok (1) reported that up to a certain point, thickness of the kernel appeared to be quite regularly correlated with its length, breadth, and weight. When the kernels were grouped according to length, breadth, and thickness, the grouping showed that the greatest thickness coincided with the largest average weight per kernel, while in the other two groups the result did not show a similar coincidence. From these various groupings, it was indicated that, in general, the length of the kernel stands in better correlation with its width than the average thickness does. It was also concluded that, while the observations were made on unhulled grains of pure strains of rice, the results would apply also to the hulled kernels.

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[1] Thesis presented for the degree of Master of Science from the College of Agriculture, No. 146; Experiment Station contribution, No. 116.

Peralta (2), working with pure strains of the varieties Binicol and Inintiw, found positive correlations within the variety of the following characters:

Weight of grain and weight of straw
Length of panicle and yield of grain
Days to maturity and leaf products
Yield of grain and height of plants.

Using the same varieties with which Peralta worked, Labrador (3) reported positive correlation between the breaking strength of culm and yield of grain.

From the findings of Peralta and Labrador, Mendiola (4) deduced "that length of culm and breaking strength are positively correlated".

Correlation among varieties.—Yamaguchi (5), using five varieties, studied the relation between the flowering time and the position of the flowers on the inflorescence on the one side and the seed weight of rice on the other. According to his findings there was a negative and slight correlation between the observed flowering time and the weight of the glumed or naked kernel; a positive correlation between the glume weight and the flowering time; and a "moderate" correlation between the glume weight and the weight of the naked kernel. It was further observed that the negative correlation between position and kernel weight was generally larger than that between the actual flowering time on a whole panicle and the kernel weight corresponding to this flowering time.

Hector (6), who carried out an intensive study on correlation of color characters, showed that many of the characters by which rice varieties differ are inherited in groups or patterns and not independently. A very interesting case of such gametic correlation has been proven to exist in one variety between the color in the ligule of the leaf and the color of the grain.

Mendiola (4) grouped the numerous character correlations of rice among varieties, studied by Jacobson in 1916 and by Vibar in 1921, as follows:

I. Positively Correlated:
  (*a*) Correlation, decided:
    Yield and tillering
    Yield and days to maturity
    Days to maturity and length of longest leaves
    Days to maturity and weight of straw
  (*b*) Correlation, marked:
    Yield and length of culm
    Yield and length of panicle
    Yield and number of nodes in the panicle
    Yield and length of grains
    Days to maturity and number of grains per panicle
  (*c*) Correlation, slight:
    Yield and number of spikes per panicle
    Yield and weight of leaves
    Yield and length of leaves
    Yield and weight of straw
    Days to maturity and length of culm
    Days to maturity and length of panicle
    Days to maturity and number of nodes per panicle
    Days to maturity and width of leaves
    Days to maturity and length of grains
  (*d*) Other positive correlations:
    Average number of days to maturity and average number of nodes per culm

Days to maturity and grain dimension ratio
Days to maturity and length of culm per variety
Length of culm and number of nodes per culm
Number of internodes per variety and average length of internodes
Average length of culm and average length of rachis per variety
Length of rachis per variety and average number of branches per variety

II. Correlation, absent:
Yield and number of grains per panicle
Days to maturity and number of culms
Days to maturity and number of spikes per panicle
Length of grain and number of culms
Tillering and grain dimension ratio
Number of culms per plant per variety and average length of culm
Length of culm and length of grain

III. Correlation, negative:
Grain width and days to maturity
Tillering and number of grains per panicle

OBJECT OF THE PRESENT WORK

The object of this study was to determine the correlation of certain characters within pure lines of rice. It is an attempt to answer among other questions whether varietal correlation may be taken as equivalent to line correlation, and, if it may, to what extent.

TIME AND PLACE OF THE PRESENT WORK

The first part of this investigation was performed by the writer during 1920-1921. The second part, which involved strain cultures, was carried on during the rice season of 1922-1923. The different strains of the varieties used were planted in the paddies at the rear of the Administration Building of the College of Agriculture, University of the Philippines, in Los Baños, Laguna, Philippine Islands.

MATERIALS AND METHODS

The materials used in this study may be discussed under: (1) Compiled data and (2) Cultural data.

COMPILED DATA

The compiled data are based mainly on Gutierrez' (7) figures on test row cultures. In 1918, Gutierrez started the study of selection among rice varieties and the isolation of several pure lines. The variability exhibited by the test rows for every variety he studied is recorded in Table I.

TABLE I.—*Variation in uniformity of varieties used in test row cultures.*

Variety.	Percentages.		
	Uniform.	Fairly uniform.	Non-uniform.
Binicol	9.1	81.8	9.1
Binangbang	29.4	64.7	5.9
Ganado	5.1	56.4	38.5
Iroy	40.0	50.0	10.0
Binalayan	22.5	52.5	25.0
Diquet a Bolilising	4.0	72.0	24.0

In Gutierrez' test row results there are figures which are available for study of correlation among pure lines within rice variety and the writer used these figures in this investigation. The figures from which the coefficients of correlation were calculated, are shown in Table II (omitted).[2]

For each variety mentioned in Table II, the coefficient of correlation was determined among the following pairs of characters:

Length of culm and total number of culms
Length of culm and number of bearing culms
Length of culm and number of days from sowing to maturity
Length of culm and number of caryopses
Length of culm and weight of caryopses
Total number of culms and number of bearing culms
Total number of culms and number of days from sowing to maturity
Total number of culms and number of caryopses
Total number of culms and weight of caryopses
Number of bearing culms and number of days from sowing to maturity
Number of bearing culms and number of caryopses
Number of bearing culms and weight of caryopses
Number of days from sowing to maturity and number of caryopses
Number of days from sowing to maturity and weight of caryopses
Number of caryopses and weight of caryopses

For the computation of coefficient of correlation among these pairs of characters, correlation tables were made. There were for this purpose, alone, 90 correlation tables which are not included in this report but which are filed in the Genetics Division of the Agronomy Department of College of Agriculture.

CULTURAL DATA

It may be of interest to know the cultural history of the pure lines of rice used in this work. Gutierrez' work was continued by Romero (8), then by Cabanos (9), and then by Bernardo (10), the Division of Genetics taking direct care of the cultures. Mendiola (11) summarized this continuous rice selection work in 1919. His summary is presented in Table III

TABLE III.—*Varieties and lines originally selected by Gutierrez and the lines surviving in 1919.*

Variety name.	Number of mother plants or lines at the beginning.	Number of lines in 1919.
Ganado	39	6
Iroy	40	8
Binalayan	40	6
Diquet a Bolilising	25	6
Binicol	12	(Discontinued)
Binangbang	21	4

[2] Tables II, VI, VIII, and X are omitted because of lack of space in **The Philippine Agriculturist**. These tables are on file in the Division of Genetics, College of Agriculture, where they may be consulted or copies will be furnished to any one desiring them.

As there was a shortage of paddies in the rice season of 1921-1922, the Division of Genetics cultured these strains on experimental upland plots. Because they were subjected to upland conditions, the yields were rather poor and a number of these varieties were lost. In June, 1922, only the lines and varieties shown in Table IV were available for planting.

TABLE IV.—*Varieties and lines cultured by Genetics Division that were surviving in 1922-1923.*

Variety name.	Number of lines.	Line number.
Iroy	6	0512 0514 0519 0525 0754 0518
Diquet a Bolilising	6	0703 0705 0716 0719 0731 0754
Binangbang	3	0811 0819 0844

The three varieties, with six lines each of Iroy and Diquet a Bolilising and three lines of Binangbang, were planted in paddies in this investigation. The plants were planted 30 centimeters apart with one plant to a hill on July 25, 1922. During the course of their growth, Binangbang was badly attacked by rice bugs and became undesirable for use in the study. Likewise, among the lines of the two remaining varieties, several were discarded on account of damage done by unavoidable flooding of the paddies. Because of these disasters to the three varieties, only two varieties of four lines each were used in this study. These varieties are shown in Table V.

TABLE V.—*Varieties and lines used in this study.*

Variety name.	Number of lines.	Line number.
Diquet a Bolilising	4	0705 0716 0719 0754
Iroy	4	0514 0518 0519 0525

The two varieties headed at about the same time. Diquet a Bolilising was the earlier, heading on November 12, 1922, while Iroy headed on November 15. The lines within each variety did not show any difference in blooming. Both varieties matured on December 28, 1922. Harvesting was done on December 29-30, 1922, for Diquet a Bolilising, and on January 1-2, 1923, for Iroy.

Getting the data.—At maturity, 100 plants from each line of a variety were marked at random. They were then pulled up, roots cleaned, and taken to the laboratory. In the laboratory the measurement of the characters was made. A total number of 800 plants were used in this study.

The length of culm was measured from the point above the roots to the first node of the panicle. The length of panicle was measured from the last node of the culm to the tip of the panicle. The sum of the nodes in each panicle was divided by the number of panicles to find the average number of nodes to a panicle. The average number of spikes to a panicle was found by the same method. The yield per plant was the total weight of the grains (air-dried for a week) produced by a plant. The weight of the straw was the total weight of the plant (air-dried for a week) less roots and grains.

The determinations based on 100 plants of each line of a variety are shown in Table VI (omitted).

Characters used in the study of correlation from figures obtained in cultures.—In this correlation study the yield per plant was used as *subject* and the following characters as *relative:*

Total number of culms
Number of bearing culms
Length of culm
Length of panicle
Number of nodes per panicle
Number of spikes per panicle
Weight of straw

The formula of Pearson was used for the computation of the coefficients of correlation. For this purpose 56 correlation tables were constructed. These tables are filed in Genetics Division of the Agronomy Department.

EXPERIMENT AND RESULTS

This investigation reports correlation of rice characters within a variety. The association of characters was determined (1) among pure lines within the variety, and (2) within individuals of pure lines of the same variety.

AMONG PURE LINES WITHIN THE VARIETY

The data in this study are based on the test row results. The class values employed were selected elites, which are the pure lines. There were six varieties. Each variety was composed of several pure lines, the characters of which were compared. The coefficient of correlation of the fifteen pairs of characters are shown in Table VII.

This table is the summary of the 90 correlation tables, which are not included in this report. One of these 90 tables is shown in Table X-a (omitted).

WITHIN INDIVIDUALS OF A PURE LINE

The data in this correlation study were obtained from the pure line cultures. There are two varieties. Each variety is represented by four pure lines. The

correlation of characters within individuals of each pure line in a variety was determined. As was mentioned in the first part of this paper seven pairs of characters were compared. Table VIII (omitted) shows the figures, or the biometrical constants, employed in the computation of correlation coefficient.

The general formula for coefficient of correlation is $r = \frac{S\ D_1\ D_2}{N\ O_1\ O_2}$ in which r is the coefficient of correlation, S D_1 D_2 equal the summation of deviations of two characters (D_1—the *subject*, and D_2—the *relative*), N—number of individuals treated (in this case it is 100), O_1 and O_2 are the standard deviations of the *subject* and of the *relative* respectively.

The probable error of the coefficient of correlation was obtained by the formula:

$$E_r = \frac{\pm\ 0.67\ (1-r^2)}{\sqrt{N}}$$

With yield per plant as the *subject* and the other characters as the *relative*, it is not difficult to find the correlation coefficient of any pair of characters, by referring to Table VIII.

Table IX gives the coefficients of correlation of characters within pure lines of each variety cultured. This is the summary of 56 correlation tables constructed for the purpose. The figures, or the coefficients of correlation, in this table may be checked by referring to Table VIII. Table X-b (omitted) is a sample of the 56 correlation tables made.

DISCUSSION OF RESULTS

In discussing the different coefficient values found in this work the following rules of King (12) for the interpretation of the coefficient of correlation according to its relation to the probable error were taken as a guide:

1. If r is less than the probable error, there is no evidence whatever of correlation.
2. If r is more than six times the size of the probable error, the existence of correlation is a practical certainty.
3. In cases where the probable error is relatively small:
   (*a*) If r is less than 0.3 the correlation cannot be considered at all marked.
   (*b*) If r is above 0.5 there is decided correlation.

CORRELATION AMONG PURE LINES WITHIN THE VARIETY

The coefficient values of certain pairs of characters of the pure lines within the variety are slightly variable. These values may be found in Table VII. The variability in the figures may be attributed to the fact that the materials used in each case were selected elites which, of course, are not much affected by law of chance when treated biometrically. However, these results would give us information as to the extent of association of characters among pure lines within the variety and among elites in particular.

Applying King's standards, it will be seen in Table VII that the correlation between length of culm and total number of culms, length of culm and number of bearing culms, length of culm and number of days from sowing to maturity, length of culm and number of caryopses, length of culm and weight of caryopses, total number of culms and number of days from sowing to maturity, number of bearing culms and number of days from sowing to maturity are either slightly negative or slightly positive, but no one of these values is significant. Marked

and positive correlation was found between total number of culms and number of bearing culms, total number of culms and number of caryopses, total number of culms and weight of caryopses, number of bearing culms and number of caryopses, number of bearing culms and weight of caryopses, and number of caryopses and weight of caryopses. The correlation between number of days from sowing to maturity and number and weight of caryopses is not clearly enough established that a definite statement can be made by the writer. While some varieties show evidence of correlation between this pair of characters, others give insignificant value.

Among pure lines of a given variety, there were some correlation coefficients which agree with those obtained from among varieties, and there were others which do not. Jacobson (13) said that among varieties the height of the plant has a noteworthy effect on the yield, in this work, however, it was found that among pure lines, culm length and weight of caryopses were not so associated as to be a practical guide in selection, that is, the association was not decided. Also, among varieties, Jacobson found that there exists a negative correlation between number of grains per panicle and tillering. In this study the writer found that among pure lines in a variety the total number of culms and number of caryopses were positively and decidedly associated.

CORRELATION WITHIN PURE LINES IN THE VARIETY

The materials used in this kind of correlation, besides being plants of one variety, are in a state of pure line. Relationship of plant characters based on this class of materials is, therefore, more reliable than that shown among pure lines within the variety.

By referring to Table IX it will be noted that the two varieties, and even the pure lines represented in each variety, exhibit variable coefficient figures for certain pairs of characters compared, although the same values in other pairs of characters run parallel.

In this study, there were found decided and positive correlations between yield and total number of culms, yield and number of bearing culms, and yield and weight of straw. There were slight correlations between yield and length of panicle, yield and number of nodes per panicle, and yield and number of spikes per panicle. On the other hand, the coefficient was very low and showed no evidence of correlation in the case of yield and length of culm.

An outstanding feature which was brought out from this correlation study, is the difference observed between the coefficients of varietal correlation (correlation among varieties) and line correlation (correlation among plants of one variety, or among individuals in the same pure line). Jacobson (13) and Vibar (14), working among several varieties, reported a marked correlation between length of culm and yield. According to their findings, tallness serves as a good index in selecting high yielders when running variety tests. In the writer's work, the coefficient of correlation applied to plants of a single variety, between length of culm and yield, was found to be slight and insignificant. In test row cultures, especially in the head-to-row experiments, tall plants are not necessarily good yielders. Peralta (2) gives a high correlation coefficient between height of plants and yield, the value approaching a perfect correlation. It must be borne in mind, however, that in Peralta's work, "the figure for height is the average height of all the culms produced in the representative plants and the yield is

the harvest". Peralta claimed that the coefficient referred to a single variety, which, he said, was supposed to be a pure strain. The difference between the coefficients reported in this work and that of Peralta may be explained on the ground that he used a smaller number of plants and a variety different from that used in the present investigation.

The correlation between yield and length of panicle was marked among varieties. Vibar reported 0.4704 ±0.0566 as the coefficient of correlation of this pair of characters. Within individuals of pure line, the coefficient is rather slight, not even more than 0.3. This illustrates that within plants of a pure strain, panicle length is not of much practical utility as a sign of a good yielding plant.

A condition similar to yield and length of culm is met with in the case of yield and number of nodes to the panicle. The present study obtained a coefficient less than 0.2, while Vibar found it to be more than 0.4 among varieties. This he considered a marked correlation. In the present work, the number of nodes to the panicle, among plants of the same line or of the same variety, has no practical value as a guide in selection, as is true of the coefficient among varieties.

The yield per plant is highly correlated with weight of straw among plants of a pure line. This pair of characters, however, is found to be slightly associated when applied among varieties.

It is to be regretted that the characters which have been studied among varieties were not all dealt with in the study of correlation within pure lines. However, it may be said that of the characters so far studied there are some which, while correlated among varieties, are not always correlated within pure lines.

CONCLUSIONS

From the results obtained in the study of correlations among pure lines within a variety and among individuals of pure lines in the same variety, the following conclusions may be drawn:

1. Among plants of a pure strain, or those in a state of pure line, culm length may not be taken as an index of a high yielding plant. Correlation among varieties showed that this pair of characters is highly and positively associated.

2. Tillering, number of bearing culms, and weight of straw are decidedly associated with yield. In varietal correlation, weight of straw is slightly correlated with yield.

3. Length of panicle, number of nodes per panicle, and number of spikes per panicle, are slightly associated with yield.

4. The pure lines in a given variety do not show significant figures as to the association of yield and days to maturity.

Some of the figures found in the present correlation study substantiate those obtained in varietal correlation, while others are not in agreement. This gives some information as to what may be expected among varieties and among plants within a variety. The importance of these relationships is realized in rice selection work. When running variety tests, varietal correlation coefficient may be taken as a guide. In pedigree cultures, where isolation of better strains, or pure lines, is the aim, the line correlation coefficient may be used, instead.

ACKNOWLEDGMENT

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LITERATURE CITED

(1) Van der Stok, J. E. Onderzoekingen omtrent rijst en Tweede gewassen. (Experiments with rice and secondary crops.) Meded. Dept. Landb. (Dutch East Indies). No. 12, pp. VI+243. 1910. (*Cited* in U. S. Experiment Station Record 26, p. 435. 1912.)

(2) Peralta, F. de A study of the relation of climatic conditions to the vegetative growth and seed production of rice. The Philippine Agriculturist **7**: 159-183. 1919.

(3) Labrador, A. F. Selection for breaking strength of culm in rice. (Thesis presented for graduation with the degree of Bachelor of Agriculture to the Faculty of the College of Agriculture, University of the Philippines, 1920. Unpublished.)

(4) Mendiola, N. B. Methods of breeding tropical crops. 260 pp. College of Agriculture. 1921. (Mimeographed.)

(5) Yamaguchi, Y. Uber die Beziehung der Aufblühzeit und des Sitzes der Blüte am Rispenaste zum Korngewichte des Reises. (The relation between the time of flowering and the position on the panicle to the weight of the rice seed.) Ber. Ohara Inst. Landw. Forsch. **1**: 451-517. 1919. (*Cited* in U. S. Experiment Station Record 45: 40-41. 1921.)

(6) Hector, G. P. Correlation of colour characters in rice. Memoirs of the Department of Agriculture in India, Botanical Series, **11**: 153-183. 1922.

(7) Gutierrez, M. E. Selection of standard Ilocano and Tagalog rices. The Philippine Agriculturist and Forester **6**: 135-163. 1917.

(8) Romero, M. L. Elite and multiplication of some standard Ilocano and Tagalog lowland rices. The Philippine Agriculturist **7**: 149-154. 1918.

(9) Cabanos, J. B. Elite, multiplication, and commercial cultures of selected strains of paddy rices. (Thesis presented for graduation with the degree of Bachelor of Agriculture to the Faculty of the College of Agriculture, University of the Philippines, 1919. Unpublished.)

(10) Bernardo, F. C. Plant-to-row tests, multiplication and commercial cultures of some selected strains of paddy rices. (Thesis presented for graduation with the degree of Bachelor of Agriculture to the Faculty of the College of Agriculture, University of the Philippines, 1921. Unpublished.)

(11) Mendiola, N. B. A review of the rice investigations at the College of Agriculture. The Philippine Agriculturist **8**: 143-156. 1919.

(12) King, W. I. The elements of statistical method. 250 pp. New York, 1916.

(13) Jacobson, H. O. Correlative characters of the rice plant. Philippine Agricultural Review **9**: 74-119. 1916.

(14) Vibar, T. Variation and correlation of characters among rice varieties with special reference to breeding. The Philippine Agriculturist **10**: 93-104. 1921.

TABLE VII.—*Showing the coefficients of correlation among pure lines of different varieties of rice.* [a]

Characters compared.	Varieties.					
	Binicol 5891 F_1	Binangbang 5892 F_1	Ganado 5893 F_1	Iroy 5894 F_1	Binalayan 5895 F_1	Diquet a Bolilising 5896 F_1
Length of culm and total number of culms	−0.140±0.162	−0.136±0.137	−0.190±0.130	−0.209±0.07	−0.054±0.150	−0.130±0.150
Length of culm and number of bearing culms	−0.370±0.160	−0.120±0.117	−0.180±0.134	−0.358±0.134	−0.117±0.141	−0.013±0.135
Length of culm and number of days to maturity	−0.199±0.179	−0.235±0.150	−0.067±0.147	−0.306±0.114	−0.127±0.126	−0.400±0.130
Length of culm and number of caryopses	0.070±0.010	0.056±0.121	0.143±0.052	0.150±0.126	0.220±0.152	0.126±0.015
Length of culm and weight of caryopses	0.220±0.192	0.000±0.120	0.051±0.126	0.113±0.117	0.042±0.126	0.095±0.128
Total number of culm and number of bearing culms	0.936±0.044	0.980±0.051	0.830±0.058	0.690±0.075	0.900±0.037	0.840±0.048
Total number of culms and number of days to maturity	0.260±0.102	0.480±0.033	0.230±0.140	0.080±0.090	0.070±0.016	0.374±0.130
Total number of culms and number of caryopses	0.792±0.083	0.725±0.861	0.770±0.069	0.456±0.102	0.590±0.091	0.794±0.010
Total number of culms and weight of caryopses	0.910±0.036	0.730±0.054	0.760±0.058	0.300±0.090	0.550±0.096	0.620±0.093
Number of bearing culms and number of days to maturity	0.320±0.169	0.000±0.130	0.230±0.061	0.012±0.108	0.120±0.137	0.096±0.148
Number of bearing culms and number of caryopses	0.810±0.071	0.790±0.048	0.720±0.067	0.630±0.072	0.610±0.066	0.870±0.058
Number of bearing culms and weight of caryopses	0.410±0.166	0.750±0.053	0.770±0.048	0.570±0.080	0.540±0.098	0.600±0.089
Number of days to maturity and number of caryopses	0.550±0.076	0.410±0.116	0.310±0.117	0.330±0.106	0.030±0.128	0.022±0.148
Number of days to maturity and weight of caryopses	0.160±0.194	0.420±0.107	0.360±0.121	0.230±0.056	0.150±0.135	0.120±0.147
Number of caryopses and weight of caryopses	0.610±0.013	0.907±0.025	0.930±0.018	0.850±0.033	0.740±0.053	0.940±0.019

[a] Summary of 90 correlation tables, which are not included in this report, but which are filed in the Genetics Division of the Agronomy Department, College of Agriculture, Los Baños, P. I.

TABLE IX-a.—*Showing the coefficient of correlation within pure lines of rice.*
Variety: Iroy 5894 F_7 [a]

Characters compared.	Pure Line 0514	Pure Line 0518	Pure Line 0519	Pure Line 0525
Yield and total number of culms	0.562±0.0455	0.300±0.0614	0.620±0.0435	0.548±0.0402
Yield and number of bearing culms	0.648±0.0391	0.622±0.0410	0.706±0.0345	0.598±0.0432
Yield and length of culm	0.092±0.0664	0.130±0.0656	0.049±0.0660	0.093±0.0663
Yield and length of panicle	0.185±0.0666	0.199±0.0643	0.164±0.0638	0.192±0.0645
Yield and number of nodes per panicle	0.180±0.0648	0.056±0.0663	0.112±0.0658	0.107±0.0569
Yield and number of spikes per panicle	0.321±0.0600	0.250±0.0623	0.132±0.0648	0.354±0.0582
Yield and weight of straw	0.630±0.0432	0.507±0.0497	0.790±0.0242	0.539±0.0475

a Summary of 28 correlation tables, which are not included in this report, but which are filed in Genetics Division, Agronomy Department.

TABLE IX-b.—*Showing the coefficient of correlation within pure lines of rice.*
Variety: Diquet á Bolilising 5896 F_7 [a]

Characters compared.	Pure Line 0705	Pure Line 0716	Pure Line 0719	Pure Line 0754
Yield and total number of culms	0.373±0.0576	0.517±0.0490	0.762±0.0287	0.548±0.0201
Yield and number of bearing culms	0.571±0.0448	0.621±0.0351	0.771±0.0271	0.555±0.0462
Yield and length of culm	0.170±0.0649	0.126±0.0656	0.107±0.0665	0.197±0.0626
Yield and length of panicle	0.192±0.0643	0.262±0.0622	0.271±0.0620	0.250±0.0623
Yield and number of nodes per panicle	0.055±0.0668	0.071±0.0665	0.110±0.0661	0.059±0.0663
Yield and number of spikes per panicle	0.186±0.0439	0.224±0.0629	0.159±0.0633	0.271±0.0620
Yield and weight of straw	0.434±0.0542	0.681±0.0391	0.770±0.0272	0.315±0.0603

a Summary of 28 correlation tables, which are not included in this report, but which are filed in Genetics Division, Agronomy Department.

THE SMUDGING OF MANGO TREES AND ITS EFFECTS[1]

By Leon G. Gonzalez

with a prefatory note by Professor J. Edgar Higgins

PREFATORY NOTE

The tillers of the soil in every land have their own practices, which, so far as their knowledge is concerned, rest wholly upon an empirical basis. Many such practices extend far back into the dim past and their origin can not now be determined. In the Philippines the custom of smoking, smudging, or heating mango trees has grown up and for the avowed purpose of causing the trees to flower and hence to produce fruit. This practice, so far as available records indicate, appears to be peculiar to this region. Its origin is not known but it is probable that after a camp fire or the burning of rubbish under a mango tree, flowers were seen on the tree which led, in time, to the trial of such fires for the specific purpose of forcing flowering. The use of smudging and heating of orchards as a protection against cold weather is, of course, widespread in modern horticultural practice but in such cases there is no desire to cause flowering and no claim that such is the result. In fact, if such were the result of smudging as practiced by commercial orchardists in frost-threatened regions, the whole purpose would be defeated. But the Filipino mango grower lights the fires under his trees for the express purpose of bringing about flowering and in so doing his custom seems to be unique although it is possible that it may be found among other related peoples in this general region of the tropics.

It is one of the functions of the technical agricultural investigator to test such practices and to determine whether beneath their empirical foundation there lies a basis of fact and whether the results have been correctly interpreted and the desired ends may be attained by the performances that are current among the cultivators. No records have been found of any scientific experiments in the smudging or heating of mango trees and the observation of the effects in relation to flowering and fruiting.

It is a well-known fact that certain sucking insects of the order Jassidae (chiefly species of *Idiocerus*) infest the mango trees in vast numbers, causing great injury to the flowers and completely inhibiting fruit production in some cases. Smoking the trees naturally drives these insects away and possibly kills many of them, especially when sulphur is added to the fire as is frequently done by the smudgers. Some observers have concluded that the entire value of smudging lies in its effects as an insecticide and an insect-repellant. On the other hand there has always been a persistent belief among the mango growers that their fires were efficacious in other ways as well as in insect control. In short, they have always been firmly convinced that their fires produce flowering at seasons when the mango tree does not normally flower, whether insects be present or not.

It has long been known that heat will cause dormant flower buds to open in midwinter. The demonstration frequently has been made in midwinter by con-

[1] Thesis presented for graduation from the College of Agriculture, No. 147, Experiment Station contribution, No. 117.

ducting a small part of a branch of a dormant tree through an opening in the wall of a warm room or a greenhouse and there the flower buds open as though spring had arrived but outside zero temperature holds the rest of the tree in a perfectly dormant state. Heat apparently is the only important variant factor in the conditions between absolutely dormant buds and those that come into full bloom. This suggests a possible analogous effect upon mango trees of the increased heat produced by smudging. It must also be remembered that the months when the process is carried on are those of slightly lowered atmospheric temperatures. What the effect of increased heat may be upon the formation of flower buds is a further question.

My student, Leon G. Gonzalez, who was at the time a candidate for the degree of Bachelor of Science in Agriculture in the University of the Philippines, undertook a study of some of these problems as a thesis investigation. His objects were first to make observation of the effects, if any, in flowering, attributable to the building of fires of different degrees of intensity under the mango trees; second to note the relation of these fires to the control of mango hoppers; and finally to note any apparent relation between such insect control and the opening of the flower buds. The accompanying paper records his method of attack and his observation. The report of the investigation constitutes a valuable contribution to horticultural literature along an unusual line of research.

INTRODUCTION

The mango tree (*Mangifera indica* Linn.) tends to produce a crop only once in two or three years and in some cases at longer intervals. If an effective means of forcing the tree to flower could be employed, the production of mango fruit could be very materially increased and this delicious fruit be supplied at times of the year other than the regular fruiting season. The selection and propagation of good yearly-bearing trees might bring about the condition of regular harvest, but this method would take time, as the mango tree requires a number of years before it comes into bearing.

There are several methods that have been tried by horticulturists for forcing the bearing of mango trees. The Porto Rico Agricultural Experiment Station (1) has employed several means to make the tree flower. Girding the branches, branch pruning, and the cutting of secondary roots have been practiced with some degree of success. In India, root pruning has been practiced to some extent and also the application of common salt to the soil. No claim, however, has been made that any of these practices have any influence in causing the tree to flower in any other than its normal season.

Smudging, a practice found in the provinces of Bulacan and Cavite in the Philippine Islands is believed by the growers in those regions to be effective in bringing about such results. Some observers are of the opinion that the result is not due to forcing, but to the control, by the smudging, of certain sucking insects. These insects are several species of Jassidae (Mango hoppers). The writer has not been able to find any record of exact experiment confirming or, otherwise, either of the two contentions.

The primary objects of the present work were to study the effect of the smudging upon the trees, the relation of such smudging to insect control and the further

relation of such control to the opening of the flower buds and the production of fruit. The secondary object of investigation was to determine the most suitable time for smudging to bring about the desired results.

The investigations were conducted in Bulacan where conditions are favorable and materials plentiful.

THE SMUDGING

MAKING THE SMUDGE

The fire used by mango growers for smudging is made of a conical pile of light combustible materials, with moist or green fuel on the top when it is desired that the heat be reduced. The size of the pile varies from half a meter to two meters in diameter, depending on the intended purpose. If it is to be used for forcing, the size is much larger than if used only to drive away insects that may be feeding on the leaves or flower buds. The size of the pile is also determined by the size and height of the tree. The taller the tree, the larger the pile, so that the smudge produced will readily reach the crown. The number of fires depends on the size of the tree. While a single fire usually produces enough smudge, still there are times when two or even three fires are needed; as when the direction of the wind changes, thus blowing the smoke in several directions, or when the volume produced is not sufficient to reach the whole crown. The fires are commonly built on the ground beneath the tree, a few meters from the main trunk. Wind-breaks of straw mats, *sawali*, or banana leaves held together by means of bamboo frames, and other similar protective materials are put around the fire. These wind-breaks check the strong currents of air and force the smoke up into the tree. Sometimes the fires are built on platforms put under the tree. The platform which rests on four bamboo posts is made of woven bamboo slats with a piece of galvanized iron or a layer of soil a few decimeters thick on top to prevent the bamboo from burning. The top part of the platform is at the center of the crown, the purpose being to place the smudge where it is most desired.

In some places in the province of Cavite a smokestack is used. This is a cone-shaped enclosure with a chimney at the top. The enclosure has an opening on the side and the whole serves as a fireplace. It is made of pieces of wood, generally green branches, held together by a frame of bamboo slats. To protect it from burning it is plastered with a thick mixture of mud held together with rice straw. The dimensions of the enclosure vary, but are never more than two meters in diameter at the base and three meters in height. At the top of this enclosure is a tall cylindrical chimney made of thin strips of bamboo woven together. The height of the chimney is generally adjusted so that the free end will reach that part of the crown where branches and leaves are most dense. Fire is built in the fireplace and the process which is described later is carried on.

Materials for smudging are easy to gather. Any cheap combustible material is believed to be well suited for the purpose. However, the material most easily obtainable, such as dried leaves, twigs, and stumps of bamboo, rice straw, branches of trees of not much value, and dried green grass are usually used. These materials are gathered a few days before smudging and kept under the tree or a shelter to keep them dry. After the smudging has been started, a man gathers fuel every day to keep the smudge burning. One man usually does all the work in smudging, with the help sometimes of members of the family or near

relatives. Paying labor to gather these materials is practiced only to a very limited extent.

PROCESS

The process of smudging is quite simple. It is a universal practice among smudgers to make the first smudge big and hot. In most cases a rather hot fire instead of a smudge is built. Sometimes the heat of the fire wilts some of the leaves of the tree causing them to fall off after a few days. The fire is kept burning for twelve hours and then green grass and small branches or bamboo stumps are put on it to produce smoke. This smudge is kept burning day and night if quick results are desired. Sometimes smudging is done at about ten in the morning and stopped in the evening. In this case the tree is not smoked if the leaves are wet either with rain or dew as it is believed that if this is done the leaves will become black and the tree will not produce flowers. Smudging is stopped after the flower cluster buds begin to burst, and before any flowers have opened. Also, if no result is obtained after twenty days of continuous smudging or sixty days of intermittent smudging as described above, the effort to force flowering ceases and the fires are allowed to die out.

SELECTING THE TREE

It is generally believed that success in bringing the tree to flower by smudging depends largely on the tree's being at the proper stage. Experience plays an important part in determining whether the tree is in proper condition for smudging. It is difficult to describe the appearance of a tree that is considered in the right condition so that the novice could judge by points given. An experienced smudger recognizes a tree as ready for smudging if it has an appearance of suspended growth, that is, advanced maturity of leaves and latest flush. The leaves are dull green and in some cases greenish brown or almost copper-colored. The copper-colored leaf stage is considered the best. The brittleness of the leaves when crushed in the hand is also an indication of advanced maturity; flexibility of the leaves suggests immaturity. The terminal buds should be dormant, but well formed. The smudgers sometimes examine these with the finger to determine whether the buds are good.

Trees, the leaves of which are not quite matured, are sometimes smudged for the purpose of hastening their maturity. In this case the smudging is not done regularly.

TIME

The best time of the year for smudging is said to be the latter part of October, the whole of November and the earlier part of December. Sometimes the smudging period is extended to the earlier part of January, but this is considered by many as not profitable since there are unsmudged trees coming into flower about February and the price for fruit may not be enough to justify the extra expense for smudging.

A settled condition of clear weather is a very important factor in smudging as the susceptibility of the flowers and fruit to disease is greater in rainy weather. During the months named as the proper time for smudging, bright weather usually occurs at intervals of about two or three weeks. The smokers do the work when they believe the weather will be good. There is a popular belief that one

week before the appearance of a new moon is the best time to begin smudging, as fewer rainy days are expected when there is a moon. The permanency of the direction of the wind and its strength are also taken into account. It is best if the wind blows from one direction, only, so that the smoke can easily be directed. High winds are undesirable.

When the flower clusters have opened to a length of about two centimeters, smudging is stopped. If, upon the opening of the buds harmful insects feed on them, smudging is again begun. This smudging is slow and not continuous or hot. Insects, usually, are troublesome when the flowers give out a strong aromatic odor. This period lasts, approximately, from three to nine days. After the odor ceases to be strong, insects are said to leave the tree and the smudge can be stopped. Smudging may be necessary when the fruit is about the size of a seed of mungo (*Phaseolus mungo* Linn.) if the trees are attacked by mango hoppers. One or two hours a day if the insects are plentiful and once or twice a week if they are not is all that is necessary. Smudging at this time is done only to drive away the insects and the abundance of these determines how much is necessary. Some smudgers use a little sulphur in the fire when the work is being done to eliminate insect pests.

EXPERIMENTS AND RESULTS

INCREASE IN TEMPERATURE IN DIFFERENT PARTS OF THE TREE

To secure data on the relative increase in temperature in different parts of the tree during the smudging process the following experiments were made:

Four mango trees under apparently similar conditions were used. They were designated as Tree I, Tree II, Tree III, and Tree IV.

Tree I was used as a check to the other three. It was not given any treatment.

Tree II was smudged, the rise in temperature being 1.05°C to 1.87°C. This represents trees smudged with "low" fire. Results from this kind of smudging were seen after a period of from thirty to fifty days at which time flowers began to appear.

Tree III was smudged with "medium" fire. The rise in temperature varied from 2.00°C to 4.15°C. With this kind of smudging, flower clusters were obtained after from fourteen to twenty days.

Tree IV was treated with a still warmer fire. The rise in temperature was from 4.4°C to 8.00°C. Results in flower clusters were obtained after from seven to twelve days.

Thermometers were hung in the different parts of each of the four trees and the temperature taken at intervals of one hour. Readings were made from six in the morning to six in the evening.

The record of temperature changes in the different parts of the tree and under different heat of smudge is given in Tables I, II, and III. The letters and figures used to indicate the locations of the thermometers are here explained.

M. T_2—Main trunk of the tree, two meters above the ground.

M. T_3—Main trunk, three meters above the ground.

M. T_5—Main trunk, five meters above the ground.

T. C.—Top of the crown, seven meters above the ground.

S_3 B_3—Side branch, three meters from the main trunk and three meters above the ground.

S_3 B_5—Side branch, three meters from the main trunk and five meters above the ground.

E. S. B.—End of side branch, six meters from the trunk and five meters above the ground.

T. O. C.—Temperature of the control tree.

The temperature in the different parts of the tree used as a check was found to be practically the same at all readings, two tenths of a degree being the greatest variation.

Tables I to III exhibit the records of temperature at all the points mentioned, except in the case of the control tree. The reading at one point only, that is at main trunk two meters above the ground, is recorded for this tree because, as stated, the temperature was practically the same throughout the tree.

RELATION OF RISE IN TEMPERATURE TO THE FORMATION OF FLOWER BUDS

To find the relation of the rise in temperature to the formation of flower buds, observations were made on trees being smudged by men who make this a business. The heat of the smudge in each case was determined by taking the temperature at two meters above the ground on the main trunk, that is, corresponding to M. T_2. The tendency of the smoke is to go upward and distribute itself fairly evenly among the different branches. The date when the smudging of each tree was begun, together with the date when results were obtained, was recorded. Each tree as to insect attacks, maturity of leaves, and terminal buds was closely examined and findings recorded. In the description of the maturity of the leaves, "mature" indicates that the leaves were well-matured, being very brittle and dull grayish green to copper-color. The buds were dormant, but filled and plump. "Flushed" indicates that the leaves were new, shortly after a new growth or flush. The terminal buds were small and loose. The leaves were light bright green in color and very pliable. The stage between "flushed" and "matured" is termed "immature". As the term suggests, the leaves were not well matured. The color was dark green. The terminal buds were forming, but not full and plump.

The observations are presented in Table IV.

FORCED FLOWERING

A second set of experiments was run to find out whether or not mango trees can be made to flower at any time of the year. In the Philippines, the mango is known to flower normally between February and the latter part of April. The plan in this set of experiments was to smudge every month from June to January. These months cover that part of the year when flowering does not normally occur.

Each of the sets of smudging are designated by a name corresponding to the month in which the smudging was done, as June Set, July Set, etc. In each case, conditions, as uniform as possible, were selected. Three trees were used in each set. One was for a check, and the other two were smudged. All trees used were in condition indicated as "mature". The records of the results are given in Table V.

EFFECTS OF SMUDGING ON MANGO HOPPERS

To find the effect of smudging on mango hoppers and the further relation of this insect to the flowering of the Mango tree and formation of fruit, the following experiment was conducted.

Four trees of apparently the same condition and all infested with mango hoppers were selected. One of the trees was used for a check while the others were smudged. At all times the fires were kept very low. This was done by putting green grass or sometimes pieces of sheet iron on the top of the fire to keep it down, so only smoke was produced. The smudging was begun December 23. During the process of smudging the trees were examined daily. After one day of smudging most of the hoppers were gone from the three smudged trees while in the check they seemed to have increased in number. After the third day, only a few hoppers could be seen in the smoked trees while in the check the number continued undisturbed. After the fifth day of smudging no hopper could be found in the smoked trees.

The process was continued until January 23. During this entire period no hopper was found in the three smudged trees while in the untreated tree they remained undisturbed. The insects came back to the smudged trees three days after smudging was stopped. None of the trees flowered. The average increase of temperature was 2°C.

The second set of experiments was begun December 26. The average change in temperature was 1.87°C. The same results were obtained as in the first set. Smudging was stopped January 24.

PROPER STAGE OF THE TREE FOR SMUDGING

Cases are known when smudging, though properly done, fails to make the tree flower. It was one of the objects of this experiment to find out if there is a condition of the tree when it responds best to smudging. Six trees were selected, two at the "mature" stage, two at the "immature," and two at "flushed". The two trees at each stage were similar and were subjected to the same conditions.

One tree at each stage was used as a check while the other was smudged. The fires built were similar in size and heat. After twelve days the "mature" smudged tree flowered quite abundantly. The "immature" tree flowered sparsely after thirty-five days. The "flushed" had not flowered at the end of sixty days. The terminal buds of this tree were examined and found to be just as when smudging was first begun. The leaves, however, were more mature than those of the check. The checks for the "mature" and "immature" did not show any appreciable change.

The experiment was run a second time, following the same procedure. The "mature" tree flowered after thirteen days. The check for this remained in the same condition as at the beginning of the experiment. The "immature" tree flowered after thirty-seven days. The check remained unchanged. The "flushed" tree had not flowered at the end of sixty days, but, again, the leaves were more mature than the check.

DISCUSSION OF RESULTS

Table IV shows that in every case, except Tree 14, flowering followed the smudging, while none of the untreated trees flowered. Tree 14 came into a new

flush. This shows that in every case there was a marked effect either in the form of flowering or a rapid increase in the rate of growth, due to smudging. It was also demonstrated that under the same condition the higher the rise in temperature the sooner the trees flowered. It was observed that during the process of smudging any degree of heat of fire can be used so long as the leaves are not burned.

The relation between the rise in temperature and the amount of flowers produced is not fully shown by the records, because only two degrees of flowering were indicated; namely "abundant" and "sparse". But observations showed that the higher the temperature, the more abundant the flowering.

From the results of this experiment it may be deduced that the flowering is due to the heat of the smudge. This is supported by the fact that the increase in temperature was directly proportional to the amount of flowers produced and varied inversely with the time required to produce flowering. Records of the experiments also show that the flowering following smudging from August to January was not due to the elimination of the insects, because these were eliminated in some experiments by light smudging but still the trees did not flower. The same experiments showed that smoke, alone, did not bring about flowering but drove out the insects.

Twigs of mango trees of the degree of maturity considered suitable for smudging were submitted to Professor F. P. McWhorter of the Department of Botany who kindly made a micro-chemical examination of the material. Twigs were also submitted from trees that had been smudged four, seven, and nine days respectively. The following very interesting memorandum on the subject by Professor McWhorter is presented:

> The dormant stem tips of the mango contain, just beneath the buds, a rather specialized storage region. In this region during the maturing of the buds the plant normally deposits a food store and a supply of enzymes for the carrying out of the metabolic processes involved in the translocation and assimilation of the food store. In such fruits as have been investigated, for example, plum, pear, etc., it is known that flowering takes place when the food supply of the stem tip has been rendered immediately available for assimilation through action of enzymes. Branches of many temperate fruits when cut in midwinter and brought into a warmer room will soon bloom. This response is due to temperature. Why a change in temperature produces such quick response is evident when we remember that many enzyme reactions are not doubled in rate every 10° change but increase five or six times. So the early flowering of mangoes after smudging may be explained as response to the constant and continued rise in temperature. The smoke probably has no stimulative effect whatever on the mangoes or their time of flowering.

It may be of importance to note that several trees were known to have flowered three or four times successively at intervals of from two to three weeks. These trees flowered from smudging, but the flowers were destroyed either by fungus or insects.

Table V shows that, except for the rainy months of June and July, the mango tree can be made to flower by smudging any time of the year. Even in the months excluded, if a fire could be kept burning, it is highly probable that flowering could be effected. However, it is impracticable to smudge during these months or at any time when the weather is not settled for the flowers would be destroyed by fungus. The records show that flowering during the month of August was

sparse. This was probably due to the fact that the fire was often put out because of rain and hence the temperature was often lowered. The same was true in the month of September.

There is no doubt that mango fruit offered in the market at an earlier season than the regular crops come on commands a maximum price. Nevertheless, it is not advisable to smudge if the weather is not settled. In this experiment it was safe to smudge beginning with the month of October, 1921, but this can not be established as a rule for every year. For increase of returns, it is not advisable to smudge during the months later than January as there are trees beginning to flower normally at this time and the difference in the price of the fruit is not enough, usually, to cover the expenses incurred in the process of smudging. There are trees that do not bear flowers every year and trees not flowering as late as the month of April are not likely to flower until the next year. In such cases it might pay to smudge the trees early in May so that the setting of the fruit would be over before the beginning of the rainy season. The experiments recorded in this paper show that the more mature the leaves of the mango tree the quicker it responds to smudging. This accounts for the fact that some trees, although smudged properly, fail to give the desired results or they flower after a much longer period than is expected. Trees with leaves not well-matured may have been selected in this case so a longer time was necessary before results were obtained.

SUMMARY AND CONCLUSIONS

1. The mango tree can be made to flower by means of smudging at any time of the year, provided that the tree is in condition for forcing.

2. It is the heat and not the smoke that causes flowering.

3. The amount of flowers produced is directly proportional to the increase in temperature within the limits of safety from burning the leaves.

4. If smudges of less intensity of heat are used, the length of time of smudging should be proportionately increased before flowers will appear and under such circumstances the flowering is likely to be less abundant.

5. Smoke drives away the insects but they return immediately after smudging is stopped.

6. The best time for smudging lies between the months of October and December, depending on weather conditions. Smudging should be done when the weather seems to be settled.

7. The best condition of the tree for smudging is when the leaves are well-matured and the terminal buds dormant and well formed.

ACKNOWLEDGMENT

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BIBLIOGRAPHY

(1) KINMAN, C. F. The mango in Porto Rico. Porto Rico Agricultural Experiment Station. Bulletin 24: 1-30. 1918.

TABLE I.—*Temperature changes with low fire.*

Time.	T.O.C.	M. T_2	M. T_3	M. T_5	T. C.	S_3 B_3	S_3 B_5	E.S.B.
	°C	°C	°C	°C	°C	°C	°C	°C
6:00 a. m.	25.00	26.50	26.50	26.50	26.50	25.50	26.00	25.90
7:00	25.00	26.60	26.50	26.50	26.50	26.50	26.10	26.00
8:00	25.30	27.10	27.00	27.00	27.00	27.00	26.50	26.50
9:00	25.40	27.10	27.00	27.00	27.00	27.00	26.50	26.50
10:00	25.50	27.30	27.20	27.20	27.00	27.00	26.50	26.50
11:00	26.00	28.00	28.00	28.00	27.50	27.70	27.50	27.50
12:00	26.30	28.20	28.10	28.10	27.90	28.00	27.80	27.70
1:00 p. m.	26.50	28.50	28.50	28.50	28.00	27.00	27.00	28.00
2:00	26.50	28.50	28.50	28.50	28.00	27.50	27.50	27.50
3:00	26.70	28.50	28.50	28.50	27.60	27.50	27.70	27.50
4:00	26.50	28.50	28.50	28.50	27.50	27.50	27.50	27.40
5:00	26.00	28.20	28.20	28.10	27.00	27.20	27.00	27.00
6:00	25.80	28.00	27.90	27.80	27.00	27.00	27.00	27.00
Average rise in temp....		1.87	1.84	1.84	1.30	1.22	1.12	1.08

TABLE II.—*Temperature changes with medium fire.*

Time.	T.O.C.	M. T_2	M. T_3	M. T_5	T. C.	S_3 B_3	S_3 B_5	E.S.B.
	°C	°C	°C	°C	°C	°C	°C	°C
6:00 a. m.	25.00	29.20	29.20	28.70	28.50	28.60	28.70	27.50
7:00	25.00	29.30	28.80	28.60	28.20	28.40	28.00	27.70
8:00	25.30	29.50	29.20	29.00	28.60	28.70	28.40	28.10
9:00	25.40	29.60	29.50	29.10	28.90	28.90	28.50	28.20
10:00	25.50	29.60	29.40	29.15	28.70	28.90	28.30	28.00
11:00	26.00	30.10	29.70	29.50	29.00	29.10	28.70	28.30
12:00	26.30	30.50	29.90	29.70	29.10	29.40	28.70	28.40
1:00 p. m.	26.50	30.60	30.20	29.70	29.30	29.50	28.90	28.50
2:00	26.50	30.50	30.10	29.80	29.20	29.40	28.80	28.50
3:00	26.70	30.65	30.15	29.85	29.30	29.50	28.90	28.50
4:00	26.50	30.40	30.10	29.70	29.00	29.30	28.50	28.20
5:00	26.00	30.05	29.70	29.30	29.00	29.00	28.60	28.25
6:00	25.80	30.00	29.60	29.30	28.50	28.70	28.30	28.10
Average rise in temp....		4.11	3.74	3.48	3.00	3.13	2.60	2.35

TABLE III.—*Temperature changes with warmest fire.*

Time.	T.O.C.	M. T_2	M. T_3	M. T_5	T. C.	S_3 B_3	S_3 B_5	E.S.B.
	°C	°C	°C	°C	°C	°C	°C	°C
6:00 a. m.	25.00	33.00	32.50	31.50	31.00	31.40	30.60	30.00
7:00	25.00	33.10	32.50	31.60	31.10	31.50	30.70	30.10
8:00	25.30	33.20	32.70	31.90	31.20	31.70	30.90	30.20
9:00	25.40	33.40	32.90	31.80	31.30	31.50	30.80	30.00
10:00	25.50	33.30	32.80	32.00	31.40	31.90	30.90	30.10
11:00	26.00	33.60	32.90	32.10	31.40	31.90	30.90	30.20
12:00	26.30	33.90	33.50	32.70	31.40	32.40	31.00	30.50
1:00 p. m.	26.50	33.90	33.40	32.60	31.50	32.30	31.20	30.40
2:00	26.50	33.90	33.50	32.70	31.50	32.30	31.10	30.40
3:00	26.70	33.95	33.60	32.75	31.70	32.40	31.40	30.50
4:00	26.50	33.90	33.50	32.70	31.50	32.40	31.50	30.70
5:00	26.00	33.60	32.20	32.30	31.20	32.20	30.90	30.50
6:00	25.80	33.40	33.00	32.30	31.00	32.00	30.70	30.20
Average rise in temp....	7.60	7.20	6.32	5.44	5.71	5.10	4.40	

TABLE V.—*Results of smudging.*

Set.	Tree No.	Smudging.		Results.	Remarks.
		Date begun.	Date stopped.		
June July		(1921-1922)			So rainy that fire could not be kept burning
Aug.	1	Aug. 2	Aug. 24	Flowered sparsely	Flowers were destroyed by fungus
	2	Aug. 2	Aug. 25	Flowered sparsely	
	check			No flower	
Sept.	1	Sept. 10	Sept. 30	Flowered sparsely	Flowers were destroyed by rain and strong wind
	2	Sept. 10	Oct. 5	Flowered sparsely	
	check			No flower	
Oct.	1	Oct. 12	Oct. 25	Flowered abundantly	Fruits were formed quite abundantly
	2	Oct. 12	Oct. 21	Flowered abundantly	
	check			No flower	
Nov.	1	Nov. 3	Nov. 16	Flowered abundantly	Fruits were formed abundantly
	2	Nov. 3	Nov. 16	Flowered abundantly	
	check			No flower	
Dec.	1	Dec. 10	Dec. 22	Flowered abundantly	Fruits were formed abundantly
	2	Dec. 10	Dec. 24	Flowered abundantly	
	check			No flower	
Jan.	1	Jan. 2	Jan. 15	Flowered abundantly	Fruits were formed abundantly
	2	Jan. 2	Jan. 16	Flowered abundantly	
	check			No flower	

TABLE IV.—*Smudging records.*

Tree No.	Smudging.			Condition.	Temperature in tree.	Temperature in check.	Temperature increase.	Flowers.	Remarks.
	Begun.	Ended.	Days.						
	(1921-1922)				°C.	°C.	°C.		
1	Aug. 2	Aug. 24	12	Mature	30.80	26.30	4.50	Sparse	Flowers destroyed by fungus.
2	Aug. 2	Aug. 25	13	Mature	30.65	26.30	4.35	Sparse	Flowers destroyed by fungus.
3	Sept. 10	Sept. 30	20	Mature	29.75	26.00	3.75	Sparse	Flowers destroyed by rain.
4	Sept. 10	Oct. 5	25	Mature	28.20	26.00	2.20	Sparse	Flowers destroyed by rain.
5	Oct. 12	Oct. 25	13	Mature	30.90	26.40	4.50	Abundant	Fruiting abundant.
6	Oct. 12	Oct. 21	9	Mature	33.50	26.40	7.10	Abundant	Fruiting abundant.
7	Nov. 3	Nov. 16	13	Mature	31.50	27.20	4.30	Abundant	Fruiting sparse because of hoppers.
8	Nov. 3	Nov. 16	13	Mature	31.60	27.20	4.40	Abundant	Fruiting abundant.
9	Dec. 10	Dec. 22	12	Mature	30.60	26.00	4.60	Abundant	Flowers destroyed by hoppers.
10	Dec. 10	Dec. 24	14	Mature	30.00	26.00	4.00	Abundant	Flowers destroyed by hoppers.
11	Jan. 2	Jan. 15	13	Mature	30.30	26.20	4.10	Abundant	Fruiting abundant.
12	Jan. 2	Jan. 16	14	Mature	30.30	26.20	4.10	Abundant	Fruiting abundant.
13	Dec. 23	Jan. 8	16	Mature	31.10	27.10	4.00	Sparse	Fruiting sparse.
14	Dec. 24	Jan. 5	12	Immature	30.15	26.40	3.75	None	Tree came into flush.
15	Dec. 24	Jan. 10	17	Mature	29.15	26.40	2.75	Sparse	Fruiting sparse.
16	Dec. 24	Jan. 7	14	Mature	30.40	26.40	4.00	Abundant	Fruiting abundant.
17	Dec. 23	Jan. 7	15	Mature	30.35	26.50	3.85	Sparse	Fruiting sparse.
18	Dec. 23	Jan. 4	12	Mature	30.50	26.50	4.00	Abundant	Fruiting abundant.

19	Dec. 24	Jan. 20	27	Immature	30.35	26.40	3.95	Sparse	Fruiting sparse.
20	Dec. 26	Jan. 12	17	Mature	30.15	26.70	3.80	Sparse	Fruiting sparse.
21	Dec. 26	Jan. 11	16	Mature	30.60	26.70	3.90	Abundant	Fruiting abundant.
22	Dec. 23	Jan. 21	29	Immature	30.40	26.50	4.00	Abundant	Fruiting abundant.
23	Dec. 26	Jan. 7	12	Mature	31.80	26.70	5.10	Abundant	Fruiting abundant.
24	Dec. 24	Jan. 21	28	Immature	30.30	26.40	3.90	Abundant	Fruiting abundant.
25	Dec. 23	Jan. 22	30	Immature	30.35	26.50	3.85	Abundant	Fruiting abundant.
26	Dec. 26	Jan. 5	10	Mature	33.45	26.70	6.75	Abundant	Fruiting abundant.
27	Dec. 20	Jan. 16	27	Immature	30.35	26.20	4.15	Sparse	Fruiting sparse.
28	Dec. 16	Dec. 25	9	Mature	33.30	26.30	7.00	Abundant	Fruiting abundant.
29	Dec. 16	Dec. 24	8	Mature	33.50	26.30	7.20	Abundant	Fruiting abundant.
30	Dec. 18	Dec. 28	10	Mature	33.40	26.40	7.00	Abundant	Fruiting abundant.
31	Dec. 17	Dec. 28	11	Mature	32.20	26.30	5.90	Abundant	Fruiting abundant.
32	Dec. 19	Dec. 28	9	Mature	33.30	26.20	7.10	Abundant	Fruiting abundant.
33	Dec. 19	Dec. 31	12	Mature	30.50	26.20	4.30	Abundant	Fruiting abundant.
34	Dec. 19	Jan. 20	32	Immature	30.20	26.20	4.00	Abundant	Fruiting sparse.
35	Dec. 20	Jan. 9	20	Mature	28.55	26.20	2.35	Sparse	Fruiting sparse.
36	Dec. 21	Jan. 8	18	Mature	29.25	26.10	3.15	Abundant	Flowers destroyed by fungus.
37	Dec. 21	Jan. 17	27	Immature	30.30	26.10	4.20	Abundant	Fruiting abundant.
38	Dec. 22	Jan. 5	14	Mature	30.05	26.30	3.75	Abundant	Fruiting abundant.
39	Dec. 22	Jan. 4	13	Mature	30.30	26.30	4.00	Abundant	Fruiting abundant.
40	Dec. 24	Jan. 5	12	Mature	30.45	26.40	4.05	Abundant	Fruiting abundant.

COMMERCIAL CITRUS PRODUCTION IN BATANGAS PROVINCE AND MEANS OF IMPROVEMENT[1]

By Crispulo G. Bagui

INTRODUCTION

There have been investigations on citrus plants in the Philippines and some articles have been published. Wester's work (1) dealing with the situation in the citrus district of Batangas was published in 1913 and that of Lyon (2) about commercial orange production in the Philippines in 1908. Mackie (3) and Reinking (4) deal with the botanical and pathological sides of the subject and the geographical distribution.

In the present article the writer attempts to discuss the commercial status of the citrus industry in Batangas Province and to suggest means by which it could be improved.

RELATION OF CITRICULTURE TO AGRICULTURAL DEVELOPMENT IN BATANGAS PROVINCE

Citriculture plays an important part in the agricultural development of Batangas Province. A considerable income is derived by the inhabitants from the cultivation of a variety of *Citrus nobilis*, commonly known as *naranjita*.

The Manila Railroad Company kindly furnished the following data which show the quantity of oranges transported by that company in the three years from 1918 to 1920.

Table I.—*Shipments of naranjita from Batangas Province in 1918-1919-1920.* a

	1918	1919	1920	Total
	kg.	*kg.*	*kg.*	*kg.*
Santo Tomás	2,847	82,330	112,655	197,832
Tanauan	683,455	2,007,573	4,611,291	7,302,319
Luta	2,211	19,306	23,405	44,922
Santo Toribio	426	6,076	150	6,652
Lipa	1,492	76,756	7,039	85,287
San José	325,074	598,506	184,931	1,108,511
Batangas	169,334	84,680	359,181	613,195
Bauan B.	33,583	23,284	21,595	78,462
	1,218,422	2,898,511	5,320,247	9,437,180

a The shipments of naranjita recorded in Table I were made from the stations given direct to Manila.

Mr. Higgins, former president of the Manila Railroad Company, estimated shipments of oranges from Batangas in 1909 and 1910 to be 737,646 kilograms and 812,833 kilograms respectively (5). Comparing these figures with those of Table I, it is seen that the orange exports from Batangas are increasing rapidly.

In spite of the increase in production the supply of citrus fruit in the Philippines is always far below the demand, as is shown by the fact that this country

[1] Thesis presented for graduation from the College of Agriculture, No. 148; Experiment Station contribution, No. 118.

imports every year mandarins, oranges, and pummelos from China; oranges, lemons, and pomelos, or grapefruit from California and Australia; and oranges and lemons from Italy and Spain (1). There appears, then, to be a good home market for citrus, and certainly one to encourage the development of the industry.

CLIMATE AND SOIL IN BATANGAS PROVINCE AND THEIR RELATION TO CITRUS GROWING

In a place where citrus growing is to be developed the climatic conditions as well as the soil must be carefully considered. Batangas enjoys the climatic conditions of the second type (6). The heaviest rainfall occurs from June to October; the medium, in November, December, April, and May; and the lowest from January to March. There are very distinct wet and dry seasons.

The citrus areas may be roughly grouped and designated as Northern, Southern, and Central in the order of their importance as citrus-producing regions. The towns which comprise the Northern, are Tanauan and Santo Tomas; the Southern, San José, Batangas, and Bauan; and the Central, Lipa, Luta, and Santo Toribio.

It is a noteworthy fact that in the districts where there is the highest moisture content of the air there is the largest supply of oranges. For instance, in Tanauan the orchards are situated mostly around Taal Lake. The southern district is much influenced by the breezes from Batangas Bay, a body of salt water.

There is a wide range of soils adapted to the growing of mandarins in Batangas. There is the fine loam of Boot, Balele, and the adjoining barrios, in the town of Tanauan; the heavy clayey soil of Batangas, Bauan, and San José; and the red adobe of Lipa, Santo Toribio, and Luta. In all these soils the mandarins do well, provided the soil is deep and well drained.

HISTORY OF CITRUS CULTURE IN BATANGAS

EARLIEST CULTIVATIONS

Not even an approximate date can be given as the beginning of citrus cultivation in Batangas Province, but the commercial cultivation began about 1872. According to Mr. Ruperto Laurel of Tanauan, there were trees sparsely scattered in the town about the middle of the last century. It is believed that the seeds used in the first planting on a commercial scale about 1872 came from those trees. In 1872, José Martin, an Augustinian Friar, started the planting of mandarins by the inhabitants of the town. Every Sunday after mass he called the "Capitan" (president of the municipal council) and "Teniente del Barrio" (Council members from each of the villages in the municipality) together in the convent and discussed with them the planting of mandarins on a large scale. Sixteen years later, that is, in 1888, there was a large production of mandarins in Tanauan.

According to Mr. Whiting's compilation relative to the industrial history of several towns in Batangas, as cited by Wester (7), the towns of Tanauan and Santo Tomas were locally noted for mandarins when the wheat blight struck these localities in the seventies. But according to Mr. Laurel there were no commercial plantings of any size before 1872. These two towns, Tanauan and Santo Tomas, passed an ordinance in that year requiring every land owner to

plant a certain number of mandarin trees. This ordinance remained in force for some years with the result that thousands of young citrus trees were propagated and set out. In this way the *naranjita* orchards came into existence.

METHOD OF CULTIVATION

In the early period of the industry the most common way of planting the seedlings was to place them in thickets of madre de cacao (*Gliricidia maculata*). Later, the madre de cacao trees, except a few left for shade, were cut down, and the leaves and stems left for mulch.

With this method of setting out the mandarin plants the orchard is not cultivated until after the first or second years of fruiting. At this period, shade trees are cut down, oftentimes the roots are dug up, and the mandarins are left unshaded; cultivation then becomes possible. Plowing and harrowing are done very close to the trees and very often not only the roots but also the trunks are injured.

During the more recent years the cultivation of the trees from their beginning is practicable since the land used for the orchard is planted to other crops. Rice, corn, and vegetables are grown as subsidiary crops between the trees until they have attained their full growth. In some cases the orchard is used as a pasture. Usually, except in a few well-kept orchards, the full grown trees appear to be given little or no cultivation at all. Even with this little care and attention given to the young plants, the trees produce superior mandarins and in such quantities as to attract much attention.

INFLUENCES ON DEVELOPMENT

Market conditions.—When the citrus industry was in its infancy the fruit was locally consumed. Later, when the planters in Tanauan and Santo Tomas produced more fruit than the people in those localities could consume some was sold to neighboring towns in Batangas Province, as Lipa, San José, Batangas, and Bauan. The people in these places seeing that Tanauan and Santo Tomas people were making money out of this crop planted mandarin trees.

One thing which brought outside demand for these mandarins is their superior quality. Wester (1) states that perhaps nowhere else in the world have superior mandarins been produced in such quantities as in Batangas Province. But no matter in what quantity they are produced, Batangas mandarins find a ready sale. So far there has never been an overproduction.

Transportation.—In 1888, that is sixteen years after the establishment of mandarin orchards in Tanauan, there was a larger production of mandarins than the people in the town could consume. So they exported the surplus to Laguna Province, principally to the municipalities of Calamba, Mamatid and other towns along Laguna de Bay, Calamba being the center of the trade. Transportation was not easy as there was no way of shipping the fruit except over trails and rough roads by men packing it; on horse back; in carreton; or, in a few cases, carretela. With the improved highway and the larger use of the carreton and carretela the outside demand increased. Consequently, citrus planters added each year a number of trees to their orchards. The eagerness to plant more trees was intensified by the news that the Manila Railroad would be extended to Batangas. So by the time the Batangas line reached its terminus in 1909 there were 547 hectares in Batangas Province planted to mandarins. These produced

6,211,500 fruits according to the estimates by Cruz (5) of the Bureau of Agriculture.

Mr. Higgins, president of the Manila Railroad Company, estimated shipments from Batangas Province to Manila for the years 1909-11, as follows: (5)

Year.	Tons.	Calculated number of oranges.
1909	726	5,260,000
1910	8,000	68,000,000
1911	427	3,000,000

The low figures for 1909 are accounted for by the fact that this branch of the railroad was completed late in the year and that large shipments were made by other means of land transportation and by water prior to completion of road. The great injury which the crop suffered from the eruption of Taal volcano in 1911 explains the low production of that year.

Diseases and pests.—Diseases and pests of citrus in the citrus districts in Batangas did not receive much attention during the early period of the industry, so very little is known as to the cause of damage either to the trees or the fruit. In the latter part of 1888, the parasite *Loranthus philippensis* Cham. was known to cause trouble in citrus groves; it is still a serious pest. An insect which the growers call *atangia* causes damage by making punctures in the skin of the fruit, thus rendering it unfit for market. It is reported, also, that this insect causes the fruit to fall. No specimens of this insect could be found by the writer. It is possible that the injury reported may have been caused by the citrus rindborer (*Prays citri* Miller) which is the larva of a moth. The female lays its eggs in the rind and when these are hatched the larvae produce protuberances on the rind.

In the investigation made in 1920-21, the writer collected specimens of diseases and pests. The diseases and pests found and the degree of damage to two kinds of citrus are recorded in Table II.

TABLE II.—*Diseases and pests attacking citrus of commercial importance, C. nobilis and C. mitis and the degree of attack on each citrus in the four principal citrus regions.*

Diseases.		Hosts.	Places found and degree of attack.			
Common name.	Scientific name.		Tanauan.	San José.	Batangas.	Santo Tomás.
Citrus canker	*Pseudomonas citri* Hasse.	*C. nobilis*	Severe	Severe	Slight	Severe
		C. mitis	Severe	Severe	Severe	Severe
Gummosis	*Diplodia*.	*C. nobilis*	Very severe	Severe	Very severe	Very severe
		C. mitis	Severe	Severe	Slight	Severe
Bark rot	*Diplodia*.	*C. nobilis*	Severe	Severe	Severe	Severe
		C. mitis	Severe	Slight	Severe	Severe
Dieback of twigs (Exanthema)		*C. nobilis*	Very severe	Very severe	Very severe	Very severe
		C. mitis	Slight	Severe	Slight	Slight
Damping off	*Sclerotium* sp.	*C. nobilis*	Slight	Slight	Slight	Slight
		C. mitis	Slight	Slight	Slight	Slight
Black mold or sooty mold	*Meliola citricola* Syd.	*C. nobilis*	Slight	Slight	Slight	Slight
		C. mitis	Slight	Slight	Slight	Slight
Insect pests.						
Black Palatoria	*Palatoria zizyphus* Lucas	*C. nobilis*	Severe	Slight	Severe	Severe
		C. mitis	Severe	Slight	Severe	Severe
Green scales	*Coccus viridis* Green	*C. nobilis*	Slight	Severe	Slight	Slight
		C. mitis	Slight	Slight	Slight	Slight
Scales	*Icerya seychellarum* Westw.	*C. nobilis*	Severe	Severe	Severe	Severe
		C. mitis	Slight	Slight	Slight	Slight
Black citrus plant-lice	*Toxoptra aurantii* Boyer	*C. nobilis*	Severe	Severe	Severe	Severe
		C. mitis	Severe	Severe	Severe	Severe
Leaf miner	*Phyllocnictis citrella* Stainton	*C. nobilis*	Very severe	Very severe	Very severe	Very severe
		C. mitis	Severe	Severe	Very severe	Severe

It is impossible to state when any of these insects and diseases first appeared, because very little attention was paid to them by the growers. Probably both the insects and diseases have been present for many years, although some may have not been recognized as pests by the owners of the trees. It is important to note that in all citrus regions investigated, scales and aphids are constantly held in check by their natural enemies, such as fungi, both the black and the red, and ladybirds.

PRESENT STATUS OF THE INDUSTRY

EXTENT OF CITRUS CULTURE

The principal citrus places in Batangas Province, named in the order of their production, are: Tanauan, San José, Batangas, Santo Tomas, Lipa, Bauan, and Luta, all of which are located on the railroad. However, in every municipality in the province one or more of the following varieties is grown to some extent: Calamunding (*C. mitis* Blanco); cahel (*C. aurantium* L.); lime (*C. medica* L.); pummelo (*C. decumana* L.); and mandarin (*C. nobilis* Lour). All these may be present in one locality, but no one of them is grown on a commercial scale except the mandarin; and this only in the seven towns mentioned.

METHODS OF PLANTING

Distance.—There are four systems of planting citrus: They are known as quincunx, hexagonal, square, and triangular, but the square system is the only one used in Batangas. In this system the rows of trees intersect each other at right angles and cultivation may be carried on in two directions.

The seedlings are planted either by the growers themselves or by hired laborers under the supervision of the growers. The latter method is preferred, because in this way the work can be accomplished quickly.

There is a good deal of variation throughout Batangas in regard to the number of seedlings planted to a hectare. Most growers plant only 300 seedlings with the view of intercropping the orchard up to the time the trees are full grown. Others plant as many as 400 seedlings to a hectare with the idea of having more trees per unit area and more fruit without regard to the inferior quality of the fruit produced. Their idea is that the more trees planted to the hectare the more fruit there will be. This, within limitations, may be confirmed by the results up to the time the trees are from 15 to 20 years old. When this age is reached the citrus growers begin to wonder why their orchards decrease in production. This falling off in production leads, oftentimes, to the neglect of the orchard, *Loranthus* is not pruned out, decaying twigs and dead branches are not removed, weeds are allowed to dominate the whole orchard, and the trees are left to struggle along without care.

It was found by the writer that the distance at which the trees are giving fairly good yield is five meters each way. The maximum distance for mandarins in Batangas Province was found to be six meters each way.

Subsequent care.—The question often arises as to the advisability of growing intercalary crops between the trees so as to get some revenue from the land while waiting for the trees to come into bearing. Such a practice is permissible only when such a crop does not interfere with the best growth of the citrus trees. The planting of corn, mungo, cowpeas, and vegetables, such as garlic and mustard, is used to advantage up to the fifth or even to the tenth year after setting out

the trees. The tilling of the soil connected with these crops gives at least four advantages. It improves the physical condition of the soil by loosening it and extending the root area; it aids in saving moisture by enlarging the water-holding capacity and by checking surface evaporation; it augments chemical action thus making inert plant food available; and it admits air to the soil.

The practice to be condemned is the neglect of the orchard entirely, except at the harvest time, after intercrops are no longer planted. This practice is not uncommon among the Batangas citrus growers. Some, however, weed their orchards two or three times a year; and some not only weed but cut out the decaying branches and dead twigs and also the *Loranthus*.

ANNUAL OUTPUT OF CITRUS

Table III shows the commercial output of citrus exclusive of the local consumption for the years 1918, 1919, and 1920 in the eight places in Batangas Province which produce mandarins on a commercial scale.

The shipping of the oranges presents no difficulty to the growers. The orchards in most cases are near good roads; labor is cheap; and the freight trains go direct to Manila. With these advantages, growers can make sales in Manila direct to dealers. In this way the citrus growers, themselves, can get the market price instead of letting middlemen make a good profit.

ENCOURAGEMENT OF GOVERNMENT TO CITRUS GROWING IN THE PROVINCE

As the industry has grown, it has reached a higher development along many lines. The methods of tillage, of propagation, of planting, and of protecting the plants against pests, among the best growers are far in advance of what they were ten or even five years ago. These improvements are traceable chiefly to governmental aid to the industry through agricultural inspectors and the agricultural experiment stations at Tanauan and at Lipa.

Since the establishment of the commercial citrus industry at Darasa, Tanauan, many of the citrus growers practice better methods of tillage; the propagation of trees by budding; and the treatment of fungus diseases, such as gumming and bark rot, by the use of carboleneum. The last two improvements were begun about the close of 1920. Bordeaux paste has been found beneficial; its use should be more widely adopted by the large growers.

ECONOMICS OF THE INDUSTRY

EXPENSES IN OPENING AN ORCHARD

Cost of seed.—Where budding is the method of propagating citrus the first step in the production of a citrus tree is the raising of the root of stock upon which the desired variety is to be budded. But in the districts of Batangas the propagating method employed is the production of citrus trees directly from seeds.

The seeds in all cases are not bought. One who wishes to establish an orchard and who does not have even a single citrus tree either buys the seedlings at 20 centavos each or gathers fallen fruit under the trees and establishes a nursery himself. Discriminating growers oftentimes buy a few fruits from selected trees for the purpose of getting the seeds. The fruit can be bought for from three to four pesos a hundred in times of plentiful harvest or at times of low prices. From 100 fruits about 2200 seeds can be secured, as 22 seeds is the average seed content of each orange fruit (5).

TABLE III.—*Annual output of oranges for 1918-1920 of the eight important citrus-producing localities in Batangas Province.* [a]

Stations.	1918 Oranges.		1919 Oranges.		1920 Oranges.		Total Oranges.	
	kg.	*No. of fruits.*	*kg.*	*No. of fruits.*	*kg.*	*No. of fruits.*	*kg.*	*No. of fruits.*
Santo Tomás	2,847	20,583	82,330	595,245	112,655	814,495	197,832	1,430,323
Tanauan	683,455	4,941,379	2,007,573	14,514,752	4,611,291	33,339,633	7,302,319	52,795,764
Luta	2,211	15,985	19,306	139,573	23,405	169,218	44,922	324,776
Santo Toribio	426	3,079	6,076	43,929	160	1,084	6,652	48,092
Lipa	1,492	10,787	76,756	554,945	7,039	50,891	85,287	616,623
San José	325,074	2,350,355	598,506	4,327,198	184,931	1,337,051	1,108,511	8,014,604
Batangas	169,334	2,224,284	84,680	612,336	359,181	2,597,878	113,195	5,434,498
Bauan	33,583	242,795	23,284	169,343	21,595	156,131	78,462	567,269
Total	1,218,422	9,809,247	2,898,511	20,956,321	5,320,247	38,466,381	9,437,180	69,231,949

[a] Weights furnished by Manila Railroad Company.

Cost of growing seedlings.—Seeds are grown in boxes 35 by 50 by 12 centimeters. From 14 petroleum boxes, 20 boxes of these dimensions can be made. The cost of these 14 empty boxes is ₱2.80; the making of the 20 propagating boxes takes a carpenter one day, wages at ₱1.20; thus making a total cost of ₱4.00 for boxes. The cost of preparing the soil is ₱2.40. It takes six months to grow seedlings ready for transplanting into the nursery. The watering of the seed boxes during these six months is attended to by a boy earning ₱240 a year, including his board. According to the citrus growers one fourth of the ₱240, or ₱60, is sufficient allowance for the watering, because the boy usually devotes three quarters of his time to other work.

The 20 boxes hold from 3000 to 4000 seedlings. These seedlings are transplanted into the nursery by four workmen and cared for during one year, each man devoting about one fourth of his time to the work and each being paid the equivalent of ₱240 a year, including his board. It takes one year to grow the seedlings in the nursery before they are ready to be planted in the field. At this time they can be sold for 20 centavos a seedling.

Table IV shows the cost of growing seedlings and the revenue from their sales.

TABLE IV.—*Cost of growing seedlings: revenue from their sale; profit.*

Items.	Expenses.	
	Pesos	
14 petroleum boxes at 20 centavos each	2.80	
Labor cost of boxes	1.20	
Cost of preparing the soil	2.40	
Cost of watering and caring for seed flats	30.00	
Cost of transplanting seedlings and nursery care	240.00	
Rental value of land	1.20	
Total		277.60
Receipts from sales		600.00
Risk and profit		322.40

Cost of preparing the land.—The land used for orchards in Batangas Province is of two kinds; hilly places covered with a thicket of madre de cacao, ipil-ipil, et cetera, or more level lands previously planted to rice, corn, sugar cane, or vegetables.

If the piece of land selected for the orchard is covered with small trees and bushes, one of two plans is adopted—partial clearing or complete clearing. The general practice is for the landowner to give the use of the land to a tenant for a period of two years free of charge for the growing of cultivated crops on condition that the land be kept clean and that citrus trees be planted by the tenant who receives one peso for each tree in good condition. Where partial clearing is made the orchardist makes a different contract with the tenant. When the trees are about one and a half meters high, the landowner pays one peso for every tree planted. Since there are from 300 to 4000 trees on a hectare the tenant gets from 300 to 400 pesos besides the benefit he has gained from planting vegetables or other crops. If the land is clean, that is, has been previously planted to other crops, no work is needed in its preparation except digging the holes, which item comes under cost of transplanting.

Cost of transplanting.—The nurseries are located near the houses of the growers to facilitate their care and management, consequently they may be a few kilometers from the field where the seedlings are to be planted. This adds to the cost of transplanting.

The seedlings are lifted from the soil and not balled. This is done by first softening the soil around the plants by watering them, then with the aid of a *dolos* (Tagalog) a dibble-like tool, the plants are gently pulled up. The seedlings are then arranged in a carreton for hauling and some soil put on the roots to prevent them from drying. It requires half a day to prepare 300 seedlings ready for transportation to the field.

The total expenses of the grower for the preparation of the seedlings, together with their transportation to the field, amounts to from ₱2.60 to ₱3.25 a hectare. For the transplanting, the laborers are paid by the number of holes dug and planted. The transplanting costs the grower from ₱30 to ₱40 depending upon the number of seedlings planted to a hectare.

Summing up all the expenses for transplanting a hectare, the cost amounts to from ₱32.60 to ₱43.25, or an average of ₱37.93

Subsequent care.—To have a successful orchard, besides the suitability of soil and climatic conditions for citrus plants there are several other points to be considered. As has been stated, few Batangas citrus growers keep their trees pruned by cutting off the decaying branches and dead twigs which may be the result of either insect or fungus attack or from malnutrition of the trees; also, only a few keep their trees pruned from *Loranthus*. Weeding is also much neglected. The grower who keeps his orchard in good condition spends as much as ₱15 a hectare a year for removing the dead branches and the parasites, and ₱12 for weeding. This outlay, however, is more than paid back by the extra crop and the extended period of the profitable life of the orchard. These and other necessary expenses may be summarized as follows:

TABLE V.—*Annual cost per hectare of operating a bearing orchard of mandarin.*

Pruning (removing *Loranthus*, dead branches, etc.)	₱15.00
Weeding	12.00
Propping	4.50
Taxes	4.69
Total	₱36.19

In estimating the amount of capital required to conduct a bearing citrus orchard for a year the estimates in Table V may be found of value. The cost of superintendence, administration, and depreciation are omitted.

AGE AT WHICH TREES BEGIN TO BEAR

The seedling mandarin begins to bear fruit when from seven to ten years old, depending largely upon the kind of soil in which it is planted and the care given it. The soil in the barrios of Boot, Balele, Janopol, Bagbag, Wawa, and in the adjoining regions around Lake Taal is sandy loam and free from hard pan. It is believed that for this reason the citrus trees in these barrios bear fruit younger than in other places in Batangas Province.

YIELD PER TREE AND PER UNIT AREA

During the first three years of fruiting an average of from 275 to 400 fruits a tree may be harvested when conditions are favorable for the production of mandarins; on the other hand, during adverse climatic conditions the yield a tree may fall to 50 fruits, and sometimes there is no harvest. A medium yield for trees of this age is considered to be 100 to 200 fruits a tree. From this time until the trees have been in bearing for ten years there should be a constant increase in annual production until they produce 3000 fruits a tree in good years, providing, of course, the trees have good care.

COST OF HARVESTING

Batangas oranges are harvested from December up to late February. The harvesting is done by men, women, and children, who are paid five centavos per hundred or a lump sum for harvesting the orchard. The first way is by far the most common as it is fair to both parties and involves less risk. The lump sum plan is resorted to in emergencies, such as may arise from typhoons or a need for immediate sale of all the fruits.

Citrus growers estimate cost of harvesting to be from ₱40 to ₱60 a hectare when the trees are from seven to ten years old; this may increase to ₱450 for a plentiful harvest from a full-grown orchard.

MARKETING

There are three different methods in Batangas of disposing of a citrus crop. It may be sold for a lump sum on the trees to an itinerant speculator who attends to the picking; or it may be contracted for by large hotels or by large market dealers in Manila and delivered as needed by the growers; or it may be sold in local markets in Batangas and neighboring provinces.

Large growers sometimes prepare to sell the fruits by the first method and thus be insured against losses due to typhoons, drought, and low prices which may prevail during harvest. Speculators usually make contracts with the growers when the fruit is still very green. Another reason for large growers selling their fruit by this method is that they escape the trouble of handling the fruit. The method of selling to local markets is followed only by the small growers.

There may be a question as to which of these methods is to be preferred. There are many instances in which the speculators have made from 50 to 75 per cent net profit. A striking instance known to the writer is the case of a grower in Tanauan, who in 1919 sold the fruit from 6 hectares for ₱8000 to a speculator who sold it for ₱12000 to another speculator who in turn sold it for ₱14000. Thus ₱6000 was made on this grower's fruit before it reached the Manila market.

The oranges are taken to the railroad station in a carreton. a full load being about 3000 oranges or approximately the yield of one full-grown tree. The cost of transportation depends upon the length of the haul, but may be estimated at approximately 50 centavos a kilometer.

RETURNS PER TREE AND PER UNIT AREA

Four of the largest plantations ranging from two to six hectares each and a one-half hectare orchard were visited for the purpose of securing data on the relation of cost and returns. It was not difficult to get comparatively exact figures on the sale of the crop in each case, but it was impossible to get anything but estimates on the cost of operation, because none of the growers consulted had done any cost accounting. Table VI shows exact data on the size of orchard, the number of trees, approximate average age of trees, and the total amount received by the owner for the crop while on the trees in 1919 which was a good citrus year. The figures of cost of operation, excepting taxes which are a known quantity, were based on estimates of the cost of each different operation gathered from a considerable number of growers.

TABLE VI.—*Comparison of expenses and returns from sales.*

Serial number of units.	Area.	No. of trees.	Age of trees.	Cost of operation (estimated).					Amount received for crop.	Gain.		
				Pruning.	Weeding.	Propping	Taxes.	Total.		Per Orchard.	Per tree.	Per hectare.
	Ha.		*years*	*pesos*	*pesos*	*pesos*	*pesos*	*pesos*	*pesos*	*pesos*	*pesos*	*pesos*
1	6.00	1,790	25	90.00	72.00	27.00	28.14	217.14	8,000.00	7,782.86	4.348	1,297.143
2	2.00	700	15	14.50	24.30	10.28	7.60	56.68	3,150.00	3,093.32	4.419	1,546.160
3	2.00	553	16	—	17.65	11.20	6.45	35.30	2,839.00	2,803.20	4.293	1,401.600
4	0.52	177	30	7.80	6.24	—	2.44	16.48	725.00	708.62	4.003	1,362.540
5	1.50	525	11	—	—	9.00	5.16	14.16	2,892.00	2,877.94	5.481	1,918.560
Totals.....	12.02	3,845	89	112.30	120.19	57.48	49.79	339.76	17,606.00	17,365.84	22.544	7,526.000
Average...	2.404	319.9	17.8	26.06	24.04	12.296	9.95	67.952	3,525.20	3,473.168	4.508	1,505.200

From Table VI it may be seen that the average receipts for the crop were ₱3,473.16 per hectare. If the estimate of cost be correct the net gain was ₱4.50 per tree or ₱1505.20 per hectare.

POSSIBLE MEANS OF IMPROVING THE INDUSTRY

Neglect and improper cultural methods are unquestionably the principal causes of low yields and of the death of the trees. Better culture is the first and most essential step in the renovation of the orchard and the eradication of the diseases prevalent in it. The following suggestions are offered:

1. All decaying branches and the rot resulting from bark diseases should be painted with whitewash or carboleneum to prevent infection from fungus diseases. The organism causing the disease known as gummosis is *Diplodia* and it was found by the writer to produce gumming in from ten to fourteen days after artificial infection. When carboleneum is used care should be taken not to let it run over the healthy bark as it is very poisonous.

2. In many places it appears to be possible to have irrigation and where this can be done at a reasonable expense it would frequently prevent the loss of a crop and would result in a better crop nearly every year. There are many streams from which to get water and in places the water level is near the surface. Parts of the citrus districts are in artesian well areas.

3. The trees should be set farther apart than the usual method of planting, say, five or six meters each way.

SUMMARY

There are eight principal citrus places in Batangas, namely, Tanauan, San José, Batangas, Santo Tomas, Lipa, Bauan, Luta, and Santo Toribio, named in the order of their importance as citrus centers. The people in these places derive a considerable income from citrus growing.

The demand for citrus is always greater than the supply as shown by the fact that the Philippines annually imports citrus fruits from China, California, Australia, Italy, and Spain.

Climate and soil conditions in Batangas Province appear to be suitable for citrus growing if proper methods of management are employed. The industry would have died out because of neglect had it not been for the suitability of mandarins to climate and soil conditions there. The mandarin does not seem to be particularly exacting as to soils so long as the physical condition is good and there is no hard pan near the surface.

The cultivation of the soil in the orchard for the purpose of planting cereals or vegetables extends very close to the trees, and the roots and trunks are often injured. This gives a good chance for fungi to enter and develop in such cuts and bruises.

At least six fungi and six insect pests are doing much damage to citrus at the present time and a good many trees die because control measures are not practiced. Dead twigs and decaying branches are not removed; weeds are allowed to dominate the orchard; and *Loranthus philippensis* apparently is unnoticed.

Good harvests of fruit are obtained from trees set five meters apart. The maximum distance of plants found in Batangas Province was six meters each way. Trees set closer together than five meters become slender and spindling as they grow old and do not bear large fruit.

If the grower is a good salesman it is frequently more profitable for him to sell his fruit direct to large consumers or to market dealers than to sell to speculators.

The cost per hectare for establishing a mandarin orchard and maintaining it to bearing age, including cost of land, is estimated to vary from ₱700 to ₱800.

As the industry is commonly conducted in Batangas, there is no fertilizer, tillage, irrigation, or mulching applied to the orchard after it arrives at bearing age.

ACKNOWLEDGMENT

The writer is greatly indebted to Professor J. E. Higgins of the Department of Agronomy for his advice and suggestions throughout the progress of this work.

BIBLIOGRAPHY

(1) Wester, P. J. Citriculture in the Philippines. Philippine Bureau of Agriculture Bulletin 27: 3-71. 1913.

(2) Lyon, William S. Commercial orange production in the Philippines. Philippine Agricultural Review **1**: 100-102. 1908.

(3) Mackie, D. B. Distribution of citrus canker. Philippine Agricultural Review **9**: 278-287. 1908.

(4) Reinking, Otto A. Philippine economic plant diseases. Philippine Journal of Science. Sec. A, **13**: 165-274. 1918.

(5) Gibbs, H. D., and Agcaoili, F. Philippine citrus fruits. Philippine Journal of Science, Sec. A, **7**: 405-414. 1912.

(6) Anonymous. Statistical bulletin No. 2 (devoted to commercial and industrial development of the Philippine Islands, compiled from official returns and other sources). 230-231. Philippine Bureau of Commerce and Industry, Manila, 1919.

(7) Wester, P. J. The situation in the citrus district of Batangas. Philippine Agricultural Review **6**: 125-130. 1913.

(8) Coit, J. Eliot. Citrus fruits. 520 pp. New York. 1920.

CURRENT ECONOMICS OF TROPICAL PRODUCTION: I

The present article is the first of a series of brief summaries on the economics of tropical crops which are intended to inform the readers of *The Philippine Agriculturist* of significant factors and agencies, and movements of considerable moment to our production.

RUBBER

Rubber has held the stage of public attention above all other tropical crops during the past few months. It has been elevated to the position of an international question where, in company with mineral-oil and sugar, it looks down on its more humble companions, the fibers, cereals, roots and the vegetable oils.

Twenty years ago rubber came only from Brazil and a few jungle points in West Africa, where it was collected by inefficient semi-savages from low yielding wild plants. But fifty years ago an enterprising and not too conscientious plant explorer spirited a few seeds out of Brazil, which had an embargo on exportation of its rubber seed, and now we find the Brazilian rubber tree at home in the Federated Malay States and the East Indies generally.

Comparing the sources of the world's rubber supply of 1900 and 1921 we find the following remarkable changes:

Source.	World's supply.	
	1900	1921
	per cent	*per cent*
Brazil and West Africa	100	10
Malay Peninsula	0	70
Dutch East Indies	0	20

Add to this the fact that in 1900 the world consumed about 70,000 tons of rubber while in 1921 the world consumed 330,000 tons, and the rapid rise and stupendous importance of this tropical agricultural industry is at once expressed.

Rubber is a necessity in two of the greatest and most flourishing industries, electrical accessories and automobile tires, and in an endless number of minor fabrications.

The geographical division of production, a normal and wholesome thing in the main, has resulted in the gravitation of 70 per cent of the world's raw rubber production to the confines of the British Empire. On the contrary, and resulting from American pre-eminence in manufacture of tires and electrical goods, the production of 50 per cent of the world's finished rubber articles occurs within the continental boundaries of the United States. When geographical division

of production draws enigmas so marked as in this case there come about powerful counter influences, mostly political, and to some extent basically uneconomic.

A nation, especially one of the American temperament, delights in self-sufficiency. Despite this fact, the United States might well have continued content in its rubber partnership with Britain were it not for the action of the British Colonial Office last November when heavy export duties were placed upon all production of rubber over 60 per cent of the bulk of the 1920 crop. The 1920 colonial crop was 344,000 tons, so the export duty becomes effective whenever, in the future, production rises above 206,400 tons. In 1922, the United States required 280,000 tons and the rest of the world an equal amount. The price of crude rubber responded to the embargo, going from 15 cents to 37 cents a pound, an increase of 250 per cent.

The export duties, under the conditions of the market, give the producers of the British Empire, and to some extent the middlemen, a virtual control of rubber. American rubber manufacturies have large holdings in the Empire but they, too, will have to pay the tax. There is absolutely no denial of British right and justice in placing the tax. The United States has ever been protectionist—protectionist in cotton, protectionist in steel. It is, of course, a fact that American protection is paid largely by the domestic consumer, whereas, the proposed rubber tax would be paid largely by the foreign importers of rubber, not by the British consumer. In the long run, it may, with fair logic, be said that the tax would encourage manufacture of tires and other rubber articles within the Empire, thus restricting purchase from the United States by British consumers. American political economy of the past fifty years has thoroughly approved of the theory of local protection in industry, although the Constitution forbids export taxes.

But just as reasonably as the United States may take no justified umbrage of the British tax on rubber, neither may the United Kingdom and its Dominions condemn with sincerity any attempt on the part of the United States to locate a more favorable producing area for its essential supply of rubber crudes. To term this attempt "bombast" and a "lick-creation" scheme is a type of journalism borrowed perhaps by British editors from our own Mr. Hearst.

The United States Government has voted half a million dollars to investigate the most desirable area in which to develop a tax-free production of rubber. The Bureau of Forestry of the Insular Government of the Philippine Islands has proposed a bill which would open up more land than the present laws permit (a paltry 2,500 acres) to centralized private leasehold with liberal renewals but with rather unattractive rentals. The bill has the approval of the Governor General; of the Legislative leaders, and if the figure on rentals can be adjudicated, also of several large manufacturers.

The possibilities of rubber production on a large scale in the Philippines rest principally upon the removal of the area restrictions on leaseholding. The control of this point is completely in the hands of the native Filipino. He, alone, may modify or change. Whether or not rubber production will be established in Mindanao depends upon effecting a most decided change in legislative policy.

There have been three phases in the attitude of the Philippine Government relative to investment of foreign capital in the Islands. The first Philippine Commission professed to welcome overseas investments of capital but made its

coming in large units impossible by placing a strict limit on the area and period of tenure of the vast unoccupied public domain. The exclusionist position taken by the doughty gentlemen of the First Commission has been explained by the editor of the Shanghai *Far Eastern Review* as a movement to protect the cane and beet sugar producers of the American continent. However, it appears more likely that the action was taken from a more worthy motive: to conserve the land of the Philippines for Filipinos alone. The policy was also in harmony with the generally extreme emphasis on conservation which obtained in the America of Roosevelt's time, an emphasis which has dulled Alaska, and, perhaps, the Philippines also. At all events, the policy did keep out predatory interest, much needed pesos, and equally valuable commercial and industrial stimuli.

The second phase of the Philippine land situation was the same as the first in effect. The Philippine Legislature, since its controlling position in 1916, has tightened the conditions and dealt most niggardly with applicants for sizable investments. This must not be presumed to have been merely a continuation of the Commission's policy. It was political and not economic. For the past fifteen years the Filipinos have been attaining and consolidating their political autonomy. Their leaders rightly assumed that if the bars were let down to foreign investment, the consummation of their aspirations would have been difficult to say the least. They were neither dense nor stingy, merely wise.

The third attitude on foreign leasehold of land begins with the present year. The process of autonomy having been carried to such a point that no considerable modification by the Metropolis is possible, the Filipinos assured by the tact and force of Leonard Wood that the administration of the Islands under the aegis of the Republican party is finally no more detrimental to national aspirations than the lack of administration under the Democratic party, feel at liberty to loosen up a bit.

Mr. Manuel Quezon, President of the Senate, in a recent address in the College of Agriculture brought out clearly the changing attitude of the legislature towards foreign capital. In his address to the graduates of the University of the Philippines, Regent Palma went further in suggesting that the failure to open up to investment might lead a following generation to condemnation of the present as unwise trustees. It has come to be realized that every year in which cogonals are kept out of cultivation adds a debit to our economic system —lowers the ratio of effective to potential wealth. Potential wealth is a fine thing, but it feeds no one, shelters no one, clothes no one. The present generation of the Islands cannot capitalize the land and it were better, economically, to lease it, let it be cleared, let it be fertilized, drained, surveyed, and let standing crops be placed upon it under nominal rental leases for from 40 to 60 years and so augment its value when the time comes that the native son is ready to take up its capitalization. It is far more shrewd to let another man paint than do it yourself, as Tom Sawyer discovered. This thesis is fortified if the owner, himself, has not the paint to apply nor the money wherewith to purchase it.

The fact, of course, remains, that twenty years of influence against foreign leaseholds under anything like attractive conditions may have worked its ends so well that ten more will be required to shift the popular sentiment. The former job was so well done that a change presents political problems.

However, with the possibilities of a change in the national attitude towards outside capital, with optimum rubber production conditions in Mindanao, with the Yankees stirring up the seven seas to escape the rubber tax, the Philippines, today, entertain brighter prospects than ever before of a rubber industry. And this may be said with good grace to our British cousins, that if we do start rubber, the chances are we shall finish it and that without permanent detriment to their interests, because the most conservative curves drive the 1950 demand for rubber above twice the present production.

Evett D. Hester,
Of the Department of Rural Economics.

COLLEGE AND ALUMNI NOTES

Dean Charles Fuller Baker went on leave of absence March 19. He is expected to return to the College sometime in July. During his absence, Professor Evett D. Hester is in charge of the Dean's Office.

Professor Harold E. Woodworth presented his resignation to the University in January. He is now connected with a commercial firm in California.

Professor J. Edgar Higgins left on April 6 for a trip to the United States where he will join Mrs. Higgins and his son who graduates from Annapolis Naval Academy in June. Professor Higgins is expected to return in September. During his absence Assistant Professor Mariano B. Raymundo is in charge of the Department of Agronomy.

Professor D. A. Herbert spent the month of May collecting botanical specimens in the Mountain Province.

Associate Professor Emma S. Yule returned from leave on April 4 and resumed her position as head of the Department of English.

Assistant Professor Ruth Taylor left on March 25 for the United States having resigned her position in the Department of English.

At the Commencement Exercises of the University of the Philippines held in Manila on April 4, 1923, the degree of Master of Science was conferred on: Angel A. Africa, '20; José M. Capinpin, '20; Esteban G. Collado, '19; Leon G. Gonzalez, '22; Fernando de Peralta, '19; Emiliano R. Roldan, '19; Victor S. Sulit, '19; Alejo T. Taleon, '21; Deogracias B. Villadolid, '19.

On the same occasion the honorary degree of Master Farmer was conferred on Florentino Cruz, '16, and Gregorio M. Francisco, '17. Mr. Cruz is a livestock farmer and Mr. Francisco, a grain farmer. The only other graduate who has been thus honored is José Zamora, '11, farmer of Silang, Cavite.

Nemesio Catalan, '20, Second Lieutenant in the 45th Infantry, Philippine Scouts, has been detailed to relieve Second Lieutenant P. C. Sevilla of the 57th Infantry in the same organization as assistant commandant in the 2nd Regiment U. P. corps of cadets, at Los Baños. Lieutenant Sevilla will be stationed at Corregidor.

Doctor Mendiola of the Genetics division and Doctor Uichanco of the Entomology department spent the second week of April on the different haciendas operated by the Mindoro Sugar Company.

A party under the leadership of Professor Elayda, Director of the Extension Service of the College, visited the citrus plantations of the towns of Tanawan and Sto. Tomas, Batangas, to investigate in a preliminary way the citrus situation in those districts. The members of the party were Doctor Mendiola of Division of Genetics, Doctor Uichanco of Entomology Department, Doctor Santos of Chemistry Department, Dr. Fronda of Division of Poultry, Mr. Peña of Animal Husbandry Department and Professor Raymundo. The party was escorted by José de Leon, '17, superintendent of the Tanawan Citrus Experiment Station of the Bureau of Agriculture.

In April, Doctor Uichanco of the Department of Entomology, spent a number of days in Balayan, Batangas, to investigate sugar cane insects. While there he was given valuable assistance by Mr. Telesforo Chuidian, a local hacendero.

A campaign is now being waged vigorously by the officers of the College of Agriculture Alumni Association to raise the necessary funds for the long talked about Alumni Hall on the Campus. The proposed plan is to raise about ₱12,000 by selling stock at ₱10.00 a share. A portion of the building will be used for dormitories to be rented to faculty members, to residents of the association, and to some seniors. From this rental the association hopes to be able to pay the annual interest on the capital and eventually pay back the capital also. Here is a chance where outsiders interested in the College of Agriculture can do their bit. Those interested may communicate with the President, College of Agriculture Alumni Association, Los Baños-College, Laguna.

Hilarion G. Henares, B. S. C. E., '19, instructor in Sugar Engineering in this College, was married on April 28 to Miss Concepción Maramba at the bride's farm home in Sta. Barbara, Pangasinan. The acquaintance leading to this happy consummation began at the University of Illinois, where Miss Maramba studied home economics and Mr. Henares, mechanical engineering. Mrs. Henares is at present head of the Department of Home Economics, University of the Philippines.

Severo G. Yap, '21, Superintendent of Momuñgan Agricultural Colony writes that if any alumnus of the College of Agriculture wants to acquire land, he better go to this colony where he can select a good farm for himself.

Tomas D. Harder, '19, was a visitor in the College from April 21 to 24. Mr. Harder is stationed at the La Paz Demonstration Station in Iloilo, and was on an official trip to study the various phases of agriculture connected with his work.

Marcelo Crisostomo, '15, is now farming in La Castellana, Negros Occidental. He has been out of the government service since 1920.

DIRECTORY OF THE COLLEGE OF AGRICULTURE ALUMNI ASSOCIATION, 1923

Abadilla, Francisco, '17, Catanawan, Tayabas.
Abesamis, Ambrosio, '21, Alabang, Rizal.
Abrajano, Quirico, '22, Los Baños, Laguna.
Acuña, Eulogio, '23, Los Baños, Laguna.
Adriano, Alfredo P., '14, Tokyo, Japan.
Adriano, Felipe T., '19, Los Baños, Laguna.
Africa, Angel A., '20, Los Baños, Laguna.
Africa, Emilio, '18, Sariaya, Tayabas.
Agati, Julian, '21, Los Baños, Laguna.
Alas, Benedicto C. de las, '21, Los Baños, Laguna.
Albano, Sotero F., '13, Vigan, Ilocos Sur.
Alcaraz, Felix, '21, Alabang, Rizal.
Alcasid, Exequiel, '19, Alabang, Rizal.
Aldaba, Vicente C., '15, care Philippine Educational Agent, Bureau of Insular Affairs, Washington, D. C.
Aldaba, Victor C., '21, Muñoz, Nueva Ecija.
Allas, Teofilo P., '21, Camiling, Tarlac.
Allarey, Vicente, '12, care Bureau of Agriculture, Manila.
Almazan, Pascual, '22, San Pablo, Laguna.
Antenor-Cruz, Gregorio J., '23, Isabela, Negros Occidental.
Aquino, Dionisio I., '21, Los Baños, Laguna.
Aquino, Emilio C., '23, Pagsanjan, Laguna.
Aquino, Severino S., '22, Los Baños, Laguna.
Aragon, Vicente B., '18, Tarlac, Tarlac.
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Asunción, Rodolfo, '21, Bulan, Sorsogon.
Aurelio, Catalino G., '15, Banga, Capiz.
Babao, Santiago, '22, Batangas, Batangas.
Bacol, Simeon D., '22, Loway, Bohol.
Bacomo, Pantaleon U., '16, Cuyo, Palawan.
Bagui, Crispulo G., '22, Los Baños, Laguna.
Bagui, Florencio G., '13, Batangas, Batangas.
Balangue, Cornelio R., '16, Tuguegarao, Cagayan.
Baltazar, Eulalio P., '22, Los Baños, Laguna.
Bartolome, Vicente C., '13, care Bureau of Agriculture, Manila.
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Bautista, Pantaleon, '18, Malabon, Rizal.
Bengzon, Arturo, '23, Camiling, Tarlac.
Bernardo, Francisco, '21, Los Baños, Laguna.

Buenaventura, Agapito E., '22, Catarman, Samar.
Cabanos, Juan B., '19, care Bureau of Agriculture, Manila.
Cagurangan, Alfonso, '16, Ilagan, Isabela.
Calingasan, Teofilo, '17, Malaybalay, Bukidnon.
Camus, José S., '14, care Bureau of Agriculture, Manila.
Canonizado, Maximo P., '20, Pagsanbangan, Tagum, Davao.
Capinpin, José M., '20, Los Baños, Laguna.
Capistrano, Severo M., '15, care Bureau of Agriculture, Manila.
Carandang, Atanacio T., '20, Pampanga Sugar Central Development Co., San Fernando, Pampanga.
Caray, Elias, '21, Los Baños, Laguna.
Carreon, Felix D., '23, Los Baños, Laguna.
Catalan, Nemesio, '20, Ft. Wm. McKinley, Rizal.
Cazeñas, Gregorio, '20, Dao, Antique.
Celis, Eugenio D., '23, Pangil, Laguna.
Cendaña, Silverio M., '21, Los Baños, Laguna.
Cevallos, Felipe, '12, care Bureau of Education, Manila.
Chanco, Antonio R., '19, care Bureau of Agriculture, Manila.
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Clemente, Leopoldo, '17, Los Baños, Laguna.
Clinton, Guy, '16, care Bureau of Insular Affairs, War Department, Washington, D. C.
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Collado, Isidoro, '20, Ballesteros, Cagayan.
Collado, Tomas G., '22, Los Baños, Laguna.
Constantino, Agripino, '15, Morong, Rizal.
Constantino, Marcelino, '16, Indang, Cavite.
Consunji, Gaudencio, '16, Hermosa, Bataan.
Corcino, Baltazar, '22, Capiz High School, Capiz.
Corrales, José P., '20, Mambajao, Misamis.
Crisanto, José, '23, Los Baños, Laguna.
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Elayda, Aniano, '20, care Bureau of Agriculture, Manila.
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Estioko, Roman P., '22, Los Baños, Laguna.
Estrada, Alberto A., '22, Los Baños, Laguna.
Ferrer, Laureano G., '23, Indang, Cavite.
Ferrer, Tomas G., '21, San Carlos, Pangasinan.
Festin, Santiago, '18, Davao, Davao.
Festin, Simplicio F., '20, Odiongan, Romblon.
Flores, Geronimo, '23, Lipa, Batangas.
Flores, Simeon, '17, Dumaguete, Oriental Negros.
Francisco, Gregorio M., '17, Sta. Rosa, Nueva Ecija.
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Fronda, Francisco M., '19, Los Baños, Laguna.
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Gavarra, Perpetuo A., '23, Lagonoy, Camarines Sur.
Ghofulpo, Teodorico G., '15, Binalbagan, Occ. Negros.
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Gordon, Alexander, '23, Los Baños, Laguna.
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Grageda, Gregorio, '17, La Union, Sigaboy, Davao.
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[1] Member by election.

Juliano, José B., '23, Los Baños, Laguna.
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Laparan, Amando, '14, Sta. Cruz, Laguna.
Layosa, Pedro, '18, Deceased.
Lazerna, Ernedo T., '22, Los Baños, Laguna.
Leaño, Benedicto, '19, Lamao, Bataan.
Ledyard, Edgar M., '13, P. O. Box 1785, Salt Lake City, Utah.
Lejano, Antonio, '13, care Bureau of Agriculture, Manila.
Leon, José de, '16, Tanawan, Batangas.
Leoncio, Martin O., '23, Bustos, Bulacan.
Limbo, Anastacio, '20, Malaybalay, Bukidnon.
Lindayag, Gaspar, '19, Deceased.
Lipayon, Anastacio, '19, Chico, Calif., U. S. A.
Lizazo, Juan G., '20, La Carlota Experiment Station, La Carlota, Occidental Negros.
Lomibao, Patricio, '23, San Carlos, Pangasinan.
Lontok, Ambrosio, '20, care Bureau of Agriculture, Manila.
Lontok, Gregorio B., '20, Los Baños, Laguna.
Lopez, Enrique, '23, Los Baños, Laguna.
Luistro, Fernando, '20, Basilan, Zamboanga.
Mabbun, Pablo N., '23, Los Baños, Laguna.
Macasaet, Valentin, '18, Iwahig, Palawan.
Maceda, Felix, '20, care Bureau of Agriculture, Manila.
Maggay, Hilario T., '22, Tuguegarao, Cagayan.
Magsino, Juan R., '20, care Lincoln Primary School, Manila.
Malabanan, Pedro L., '23, Lipa, Batangas.
Mamaril, Julian A., '23, San Carlos, Pangasinan.
Manio, Melecio M., '19, Isidro, Nueva Ecija.
Manio, Ramon V., '20, Calumpit, Bulacan.
Mañalac, J. San Juan, '23, Baliwag, Bulacan.
Mañgonon, Alejandro, '20, Manauag, Pangasinan.
Manza, Artemio, '21, Los Baños, Laguna.
Mariano, José, '18, Bigaa, Bulacan.
Mariano, Severo J., '20, care Audubon Sugar School, Baton Rouge, Louisiana.
Marilao, Venerando P., '22, Maao Sugar Central Co., Inc. Pulupandan, Occidental Negros.
Marquez, Francisco D., '16, care Bureau of Agriculture, Manila.
Marquez, Severo L., '21, P. O. Box 202, Iloilo, Iloilo.
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Medalla, Mariano G., '17, care Bureau of Agriculture, Manila.
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Mendiola, Nemesio B., '14, Los Baños, Laguna.

Mendoza, Francisco M., '22, Isabela, Occidental Negros.
Mendoza, Leopoldo G., '17, Mabatobato, Pili, Camarines Sur.
Merino, Gonzalo, '14, care Bureau of Agriculture, Manila.
Mirasol, José J., '15, Cebu, Cebu.
Miniano, Geronimo, '21, care Bureau of Agriculture, Manila.
Miraflores, José C., '15, Manapla, Occidental Negros.
Moncerate, Benito N., '22, San Joaquin, Iloilo.
Mondoñedo, Mariano . . ., Los Baños, Laguna.[1]
Montellano, Pedro L., '15, Muñoz, Nueva Ecija.
Morada, Emilio K., '20, Lamao, Bataan.
Morada, Julián A., '20, Lipa, Batangas.
Muñoz, Apolonio R., '13, Juban, Sorsogon.
Nación, Cipriano C., '23, Los Baños, Laguna.
Narabal, Tiburcio, '19, care Bureau of Agriculture, Manila.
Navarro, Andres, '12, Baguio, Mountain Province.
Neric, Juan I., '21, Camalig, Albay.
Nisce, Teofilo, '19, care Bureau of Agriculture, Manila.
Noguera, José, '19, Batangas, Batangas.
Novero, Teofilo, F., '22, Los Baños, Laguna.
Obias, Feliciano C., '21, Lagonoy, Camarines Sur.
Ocfemia, Gerardo O., '15, Los Baños, Laguna.
Octubre, Francisco P., '15, Rosales, Pangasinan.
Olofernes, Bernabé, '23, San Fernando, Pampanga.
Opiana, Gil O., '23, Los Baños, Laguna.
Otanes, Faustino Q., '18, care Bureau of Agriculture, Manila.
Padilla, Bonifacio, '22, Sta. Rosa, Nueva Ecija.
Padlan, Policarpo, '20, Lipa, Batangas.
Padolina, Felipe B., '18, Lamao, Bataan.
Paglinawan, Sergio, '23, Bacacay, Albay.
Pagsolingan, Juan G., '23, San Carlos, Pangasinan.
Paguirigan, Domingo B., '16, care Bureau of Agriculture, Manila.
Palafox, Gaudencio, '16, Gamu, Isabela.
Palafox, Serapio M., '20, San Nicolas, Ilocos Norte.
Panganiban, Elias H., '15, 123 Quarry St., Ithaca, N. Y.
Panganiban, Simeon, '20, Malabang, Lanao.
Pastorfide, Dionisio B., '17, Lucena, Tayabas.
Paz, Alfonso de la, '18, Lipa, Batangas.
Paulican, Cenon, '17, Bagumbaan, Bukidnon.
Paulino, Pedro, '20, care Bureau of Agriculture, Manila.
Peliño, Anacleto R., '22, Indang, Cavite.
Peña, Daniel B., '22, Los Baños, Laguna.
Peralta, Fernando de, '19, Los Baños, Laguna.
Pereira, Eufemiano de Braganza, '21, Goa, Portuguese India.
Piguing, Rafael M., '22, Los Baños, Laguna.
Ponce, Basilio F., '22, No. 6 Int. Cabral, Ermita, Manila.
Pugeda, Melquiades S., '20, Los Baños, Laguna.
Pulgar, German M., '22, Lingayen, Pangasinan.

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[1] Member by election.

Punzalan, Edilberto S., '22, Los Baños, Laguna.
Quisumbing, Eduardo, '18, Los Baños, Laguna.
Quisumbing, Francisco, '14, care University of the Philippines, Manila.
Racelis, Antonio P., '15, care Bureau of Forestry, Manila.
Ramos, Florentino, '20, Deceased.
Raymundo, Mariano B., . . ., Los Baños, Laguna.[1]
Rayos, Catalino R., '22, Lingayen, Pangasinan.
Red, Francisco R., '19, Naga, Camarines Norte.
Reveche, Feliciano R., '23, Los Baños, Laguna.
Reyes, Antonio S., '21, Los Baños, Laguna.
Reyes, Gaudencio M., '20, care Bureau of Agriculture, Manila.
Reyes, José C., '23, Malolos, Bulacan.
Reyes, Rufo, '21, Siniloan, Laguna.
Reyes, Simon, '17, care Bureau of Agriculture, Manila.
Reyes, Teodorico P., '21, Los Baños, Laguna.
Ricafrente, Quirino P., '21, Muñoz, Nueva Ecija.
Roa, Manuel A., . . ., Los Baños, Laguna.[1]
Rocafort, Antonio L., '22, Los Baños, Laguna.
Rodis, Filoteo B., '22, Los Baños, Laguna.
Rodriguez, Agustin Y., '23, Albuera, Leyte.
Rodrigo, Pedro A., '21, Los Baños, Laguna.
Rojales, Pedro S., '20, Indang, Cavite.
Roldan, Emiliano F., '19, Los Baños, Laguna.
Romero, Leon, '18, San Carlos, Pangasinan.
Roque, Damaso, '22, Canlubang Sugar Estate, Calamba, Laguna.
Royeca, Simeon G., '22, Lingayen, Pangasinan.
Roxas, Manuel L., '11, Los Baños, Laguna.
Rowan, Anastacio A., '23, Banga, Capiz.
Sabado, Raymundo, '19, San Fernando, La Union.
Sablan, Eladio, '14, care Bureau of Agriculture, Manila.
Sadorra, Nazario M., '23, Los Baños, Laguna.
Sagun, Casimiro de, '22, Los Baños, Laguna.
Salinas, Leonardo, '21, Sandakan, Borneo.
Salva Cruz, Sebastian R., '21, Los Baños, Laguna.
Samonte, Claro, '18, Bayombong, Nueva Vizcaya.
San Miguel, Lucio A., '16, Deceased.
Sanchez, Antonio C., '22, Clarin, Bohol
San José, Primo C., '23, Cardona, Rizal.
Santos, Francisco B., '18, Laoag, Ilocos Norte.
Santos, Francisco O., '19, Los Baños, Laguna.
Santos, Gregorio, '18, care Bureau of Agriculture, Manila.
Santos, Severino R., '22, Hagonoy, Bulacan.
Santos, Severino R., '22, Hagonoy, Bulacan.
Sarmiento, Valeriano M., '22, Los Baños, Laguna.
Sarao, Felix B., '17, care University of Wisconsin, Madison, Wisconsin, U. S. A.
Serrano, Ciriaco B., '22, Los Baños, Laguna.
Serrano, Felicisimo, '19, care Bureau of Agriculture, Manila.

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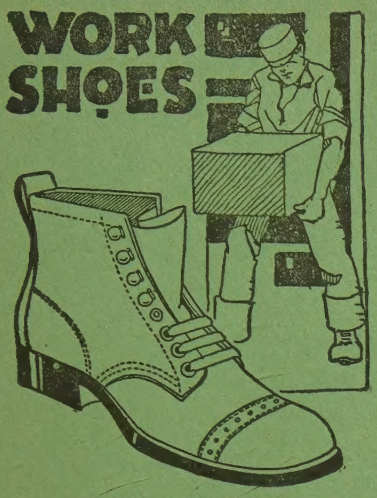
[1] Member by election.

Silayan, Hilarion, '17, Chico, California, U. S. A.
Sison, Pedro L., '21, Angono, Rizal.
Soliven, Florencio, '21, Los Baños, Laguna.
Soriano, Antonino M., '22, Lingayen, Pangasinan.
Sulit, Victor, '19, Los Baños, Laguna.
Talento, Apolinar S., '23, Abucay, Bataan.
Taleon, Alejo T., '21, Los Baños, Laguna.
Telado, Felix, '22, Alilem, Mountain Province.
Tempongco, Clodoaldo, '11, Deceased.
Tenebro, Magno T., '23, Sibonga, Cebu.
Teodoro, Anastasio L., '18, Los Baños, Laguna.
Teodoro, Nicanor G., '15, care Bureau of Agriculture, Manila.
Teruel, Eusebio T., '23, Tigbauan, Iloilo.
Tirona, José P., '14, Cavite, Cavite.
Tomaneng, Roman G., '2), Central Philippine College, Jaro, Iloilo.
Torres, Juan, '19, Alabang, Rizal.
Trinidad, José, '18, Philippine Law School, National University, Manila.
Tuason, Dionisio, '17 Deceased.
Tuason, Nicasio A., '23, Los Baños, Laguna.
Ureta, Eligio C., '21, Los Baños, Laguna.
Uichanco, Leopoldo B., '15, Los Baños, Laguna.
Unite, Juan O., '21, Los Baños, Laguna.
Velez, Blas C., '15, San José, Mindoro.
Ventura, Tranquilino, '19, Pampanga Sugar Development Co., San Fernando, Pampanga.
Vibar, Toribio, '12, Los Baños, Laguna.
Vicencio, Arsenio S., '15, Mexico, Pampanga.
Villadolid, Deogracias, '19, Los Baños, Laguna.
Villamil, Aniceto, '15, Dumaguete, Oriental Negros.
Villanueva, Crispin, '20, Pikit, Cotabato.
Villanueva, Leon B., '20, Deceased.
Viado, Basilio O., '22, Cavite High School, Cavite,
Villaraza, Mariano F., '20, Lamao, Bataan.
Villegas, Valente, '13, Los Baños, Laguna.
Villyar, Paul, '17, Alabang, Rizal.
Vista, Tomas I., '15, Rizal, Laguna.
Yap, German, '19, Tagbilaran, Bohol.
Yap, Severo G., '21, Camp Keithley, Dansalan, Lanao.
Zabella, Gaudencio C., '21, Tayabas, Tayabas.
Zamora, José, '11, Silang, Cavite.
Zamuco, Calizto T., '23, Los Baños, Laguna.
Zulaybar, Eutiquio Q., '14, care Bureau of Agriculture, Manila.



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